UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

JAN 6 2006

In response refer to:
151422SWR2005SA00266:HLB

Donna E. Tegleman
Regional Resources Planner
United States Bureau of Reclamation
2800 Cottage Way
Sacramento, California 95825

Dear Ms. Tegleman:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) biological opinion (Enclosure 1) based on our review of the proposed Reclamation District 108 (RD 108) Combined Pumping Plant and Fish Screen project in Yolo and Colusa Counties, California, and its effects on Federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), and their designated critical habitat in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your April 29, 2005, request for formal consultation was received on May 2, 2005. Formal consultation was initiated on May 2, 2005.

This biological opinion is based on information provided in the April 2005 Action Specific Implementation Plan (ASIP), and discussions held at meetings with representatives of NMFS, the U.S. Fish and Wildlife Service (USFWS), the California Department of Fish and Game (CDFG), the U.S. Bureau of Reclamation (BOR), and RD 108. A complete administrative record of this consultation is on file at the NMFS Sacramento Area Office.

Based on the best available scientific and commercial information, the biological opinion concludes that this project is not likely to jeopardize the listed species or adversely modify the conservation value of their designated critical habitat. NMFS also has included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to minimize incidental take associated with the RD 108 Combined Pumping Plant and Fish Screen project.

Also enclosed are Essential Fish Habitat (EFH) conservation recommendations for Pacific salmon as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended (16 U.S.C. 1801 *et seq.*; Enclosure 2). This document concludes that the RD 108 Combined Pumping Plant and Fish Screen project will adversely affect the EFH of Pacific Salmon in the action area and adopts certain terms and conditions of the incidental take statement and the ESA conservation recommendations of the biological opinion as the EFH conservation recommendations.

Section 305(b)4(B) of the MSA requires BOR to provide NMFS with a detailed written response within 30 days, and 10 days in advance of any action, to the EFH conservation recommendations, including a description of measures adopted by BOR for avoiding, minimizing, or mitigating the impact of the project on EFH (50 CFR §600.920[j]). In the case of a response that is inconsistent with our recommendations, BOR must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

If you have any questions regarding this correspondence please contact Mr. Howard Brown in our Sacramento Area Office, 650 Capitol Mall, Suite 8-300, Sacramento, California 95814. Mr. Brown may be reached by telephone at (916) 930-3608 or by Fax at (916) 930-3629.

Sincerely,

Rodney R McInnis

Rodney R. McInnis
Regional Administrator

Enclosures (2)

cc: NMFS-PRD, Long Beach, California
Steve Thomas, NMFS, Santa Rosa, California
Mary Grim, Bureau of Reclamation, 2800 Cottage Way, Sacramento, California 95925
William O'Leary, USFWS, 2800 Cottage Way, Sacramento, California, 95825
Paul Ward, CDFG, 2545 Zanella Way, Suite F, Chico, California 98928
Lu Hinz, RD 108, P.O. Box 50, Grimes, California 95950

Enclosure 1

BIOLOGICAL OPINION

ACTION AGENCY:	U.S. Bureau of Reclamation, Mid-Pacific Region
ACTIVITY:	Reclamation District 108 Combined Pumping Plant and Fish Screen Project
CONSULTATION CONDUCTED BY:	NOAA's National Marine Fisheries Service, Southwest Region
FILE NUMBER:	151422SWR2005SA00266:HLB
DATE ISSUED:	JAN 6 2006

I. CONSULTATION HISTORY

In 1997, Reclamation District 108 (RD 108) signed a Letter of Intent with the California Department of Fish and Game (CDFG), NOAA's National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Bureau of Reclamation (BOR), committing to work cooperatively to develop solutions to prevent the entrainment of fish at RD 108's seven pumping plants on the Sacramento River.

The RD 108 Combined Pumping Plant and Fish Screen project was developed over the course of several years, beginning in 2003, at meetings of the Anadromous Fish Screen Program (AFSP) Technical Team. RD 108, CH2M Hill, and Hanson Environmental, Inc. developed the project design with technical input from the AFSP Technical Team.

On August 30, 2004, Mary Grim, of BOR, provided NMFS with an electronic copy of the draft Action Specific Implementation Plan (ASIP) for the RD 108 Combined Pumping Plant and Fish Screen project.

On November 2, 2004, representatives from NMFS, USFWS, BOR, and RD 108 met to discuss the reviews and revisions to the ASIP.

On February 4, 2005, NMFS biologist Howard Brown issued a memo to Mary Grim, of BOR, providing comments on the draft ASIP.

On May 2, 2005, BOR requested formal consultation with NMFS for the RD 108 Combined Pumping Plant Fish Screen project in Yolo and Colusa Counties, California. The request for consultation included the final ASIP for the proposed action.

On June 5, 2005, NMFS advised BOR that formal section 7 consultation was initiated upon receipt of BOR's May 2, 2005, request.

This biological opinion is based on information provided in the ASIP, discussions held at AFSP Technical Team meetings, discussion between Howard Brown of NMFS, Chuck Hanson of Hanson Environmental, Inc., Paul Ward of CDFG, and Mary Grim of BOR. A complete administrative record of this consultation is on file at the NMFS Sacramento Area Office.

II. DESCRIPTION OF THE PROPOSED ACTION

BOR and RD 108 propose to construct and operate a new pumping plant and fish screen along the west bank of the Sacramento River, near river mile (RM) 110.3, and decommission and remove three existing unscreened pumping facilities at Boyers Bend (RM 111), Howells Landing (RM 109), and Tyndall Mound (RM 105.7). The proposed fish screen project is identified in the California Bay-Delta Authority (CALFED) Ecosystem Restoration Program's (ERP) Draft Stage 1 Implementation Plan as a project that will result in progress towards meeting CALFED goals for at-risk salmonids. The new pumping plant and fish screen will have a diversion rate of 300 cubic feet per second (cfs), and will be constructed to meet all CDFG and NMFS fish screen criteria. The combined pumping rate of the three pumping plants to be removed is approximately 377 cfs. The proposed action includes construction of new facilities, decommissioning of existing facilities, operations and maintenance, conservation measures, and monitoring.

In addition to the fish screen and pumping facilities, the consolidation of three diversion points will require changes to the canal and irrigation network. These project elements are on the inland side of the Sacramento River levee and will have no effect on Federally listed salmonids or their designated critical habitat. Therefore, these elements will not be considered further in this biological opinion.

A. Construction

The new fish screen and pumping facilities will be constructed on 4.4 acres of land on the river side of the levee, along a 300-foot-long outside bend of the Sacramento River. The fish screen will enclose the fish screen forebay and the diversion pumps will remove water from the forebay. The fish screen structure will be made of reinforced concrete, with all construction activities occurring behind a cofferdam to allow construction in dry conditions. Once the new fish screen and pumping facilities are constructed, three existing unscreened diversion facilities will be decommissioned. Primary construction activities include: (1) installation of cofferdams, and site preparation of the construction area; (2) construction of the forebay and fish screen structure; and (3) decommissioning of the three existing diversion facilities.

1. Cofferdam Installation and Site Preparation

A sheet pile cofferdam will be installed around the 300-foot-long construction site using barge-mounted impact pile-driving equipment. Once the cofferdam is installed, the construction area will be dewatered and the site will be prepared for construction. Site preparation will include vegetation removal, site clearing and construction of access roads on the north and south sides of the proposed facility.

2. Construction of the Forebay and Fish Screen Structure

Installation of the facility will require construction of a 270-foot by 90-foot concrete-lined forebay, and a 105-foot by 26-foot fish screen structure. The fish screen will enclose the forebay and isolate it from the Sacramento River. The fish screen structure will be made of reinforced concrete, with stainless steel screen plates. The fish screen will be comprised of 5, 15-foot by 13-foot screen bays contained in stainless steel guides. Fish screen panels will consist of stainless steel vertical wedge wire with 1.75 millimeter (mm) slot openings. The total effective fish screen area will be 909 square feet. Screen panels will be installed using a mobile crane. Each screen panel will be removable to allow for annual pressure washing, cleaning and maintenance, as well as inspection of screen integrity.

Once the fish screen panels are installed, a mechanical brush cleaning system will be installed along the screen face, and a 24-foot wide deck will be constructed on top of the screen for operations and maintenance access. Other associated features that will be installed include motor-controlled intake gates, five discharge pipes with flap gates, a floating log boom, a sediment jetting system, and rock riprap. The floating log boom will be installed along the screen face to deflect floating debris, and prevent material from being impinged on the screen, damaging screen panels, or damaging the traveling brush cleaner. Approximately 25 feet of rock riprap outside of the cofferdam area will be removed for construction. This rock will be replaced to protect the fish screen foundation from river scour and maintain levee stability in the immediate vicinity to the fish screen structure. Riprap material used as part of the proposed project will be similar to that currently existing at the project site, and will consist of natural rock ranging from 2 feet to 4 feet in diameter.

The cofferdam will be removed upon completion of the pumping plant and fish screen facility. Portions of the cofferdam that have been incorporated into the foundation of the facility will be cut at the screen sill elevation. Other portions will be cut at the elevation of the riverbed. Pilings will be cut underwater by divers with torches.

3. Decommissioning Existing Diversions

The existing Boyers Bend, Howells Landing, and Tyndall Mound pumping plants will be decommissioned and removed once the new fish screen and pumping plant are constructed and operational. Divers will cut pipes, and debris will be removed from the Sacramento River using an on-shore crane.

B. Construction Schedule

Construction of the pumping plant and fish screen is expected to take up to 24 months. Installation of the cofferdam could occur anytime between April and November 1, depending on funding and permitting schedules, and is expected to take up to 60 days to complete. Once the cofferdam is in place, construction of the remaining project features will occur year-round through project completion. Following installation of the fish screen and associated facility features, the cofferdam will be cut off at the base of the fish screen structure, construction equipment will be removed, and the site will be stabilized. Cofferdam removal is expected to take up to 30 days to complete and could occur during any time between April 1 and November 1. Decommissioning of existing diversion facilities will occur in late summer and is expected to take from 7 to 14 days for each site.

C. Operation and Maintenance

RD 108 will operate the facilities to pump water from the Sacramento River pursuant to a 2005 settlement agreement, long-term CVP water contracts, and other existing water rights, to provide water approximately 48,000 acres of irrigated farmland. Pumping rates may vary depending on demand and water year type, but generally will not exceed 300 cfs between April 1 and October 30. Water demand is highest between May 1 and October 1. RD 108's water diversions pursuant to BOR's long-term water contracts on Federally listed anadromous salmonids were previously analyzed in the OCAP BO.

The fish screen is designed to meet CDFG and NMFS fish screen criteria at a wide range of river flows and pumping condition. The screen will operate effectively between water surface elevations of 23.3 feet to 51.6 feet. Design parameters are described in Table 1.

Table 1. Design parameters for RD 108 combined pumping plant and fish screen project.

Parameter	Design Criteria
Design flow	300 cfs
Approach velocity	0.33 feet/second
Effective screen area	909.1 square feet
Effective screen panel area	187.7 square feet
Number of screen panels	5
Screen slot opening size	1.75 mm
Wire orientation	Vertical
Total facility length/Total screen length	105 feet/81 feet
Minimum sweeping velocity	2.7 feet/second
Sweeping to approach velocity	8.1
Exposure time	30 seconds
Screen deck elevation	51.6 ft (100 year flood elevation)

Operation and maintenance activities will be necessary to maintain function of the fish screen and the pumping plant for the life of the facility. The fish screen structure will be constructed to permit vehicle access for screen panel removal and maintenance. The fish screen will be operated and maintained to reduce debris and sediment accumulation that will adversely affect the magnitude and uniformity of approach velocities by creating turbulence in front of the screen.

The mechanical cleaning brush is designed to remove accumulated debris from the screen surface and help insure that the fish screen operates in accordance with the approach velocity design criteria. The mechanical cleaning brush will be operational throughout the period of diversion operations. The cycle time for the brush cleaning system will be less than five minutes. In addition to the screen cleaning brush, individual screen panels will be removed periodically for inspection and removal of debris. A portable, high-pressure wash water system will be used to facilitate screen panel cleaning. A sediment jetting system installed in the fish screen bay will also reduce sediment deposition and accumulation within the fish screen. The sediment jetting system will include a series of pipes located on the bottom of the intake forebay, each having a series of nozzles that will be designed to cause turbulence and re-suspend sediments deposited within the forebay which could then be removed by diversion pumps and transported to the distribution canals, thereby reducing the need for maintenance dredging within the forebay as part of fish screen maintenance.

Intake maintenance will be conducted with a boom truck or mobile crane to remove individual screen panels for cleaning, maintenance, and repair as needed. Prior to each irrigation season, screen panels will be removed for inspection, repair, and high-pressure washing. Backup panels will be available on-site to replace screen panels that require maintenance or repair. Periodic maintenance dredging will be performed as part of this project to remove accumulated sediments. Dredging will occur within the intake forebay and should not occur within the Sacramento River, along the base of the fish screen foundation.

The fish screen may be overtopped during high flows that generally exceed a 100 year occurrence frequency. The facility is designed to withstand these events, and to drain naturally into the Sacramento River as flows recede.

D. Proposed Conservation Measures

Conservation measures incorporated into the project design to avoid or minimize impacts to listed species, include:

1. Turbidity Control During Construction

   The project will comply with State and Federal water quality control standards throughout the construction period. Turbidity measurements will be taken two times per day during the construction period to maintain compliance with Regional Water Quality Control Board (Regional Board) requirements.

   Additionally, the project has integrated the following conservation measures for dredging and spoil disposal as described in Appendix A, Fisheries Management Plan for Essential Fish Habitat for Pacific Salmon:

- Using collaborative approaches to promote the use of best management practices (BMPs) to control sediment input.

- Monitoring dredging activities and report the effects on salmonid habitat.

- Employing best engineering practices and management practices to minimize water-column discharges.

- Avoiding dredging during juvenile outmigration.

- Using upland disposal as an alternative to open water disposal.

2. Erosion Control Plan and Stormwater Pollution and Prevention Plan

A soil erosion control plan will be prepared by the contractor prior to grading and excavation activities to minimize potential effects of silt entering the river and increasing river turbidity. The project specifications require that the construction contractor prepare an erosion control plan and a stormwater pollution prevention plan. The construction contractor for the proposed project, using the services of a certified erosion control specialist or California-registered civil engineer, will prepare the plan. The plan will be prepared and implemented before the construction phase begins. CDFG, Regional Board staff, and RD 108 will review the plan to verify that BMPs have been incorporated to reduce erosion and sedimentation to the maximum extent possible and ensure compliance with this measure. Erosion and sedimentation will be reduced to the maximum extent possible according to the BMPs being used. The plan will include, but will not be limited to, the following measures to minimize erosion and sedimentation:

- Using sedimentation basins, straw bales or other measures to trap sediment and prevent it from entering the Sacramento River during construction.

- Covering graded areas adjacent to the levee with protective material, such as mulch, and re-seeding with appropriate native plant species after construction is complete.

- Incorporating retaining walls into the project design on both the north and south sides of the intake forebay to minimize erosion of soils into the Sacramento River.
- Minimizing surface disturbance of soil and vegetation.

- Placing stockpiled soil where it will not be subject to accelerated erosion.

3. Water Quality Management

Conservation and avoidance measures will be implemented in accordance with the Regional Board requirements. Water quality surveys will be conducted during dredging operations and installation/removal of the cofferdam to ensure that turbidity levels do not increase in surface waters above the criteria described below. The project field manager will be responsible for monitoring in accordance with established protocols and survey procedures. In the event that turbidity levels exceed the prescribed limits, RD 108 will notify the Regional Board, BOR, CDFG, and NMFS immediately.

- The discharge of petroleum products or other excavated materials to surface waters is prohibited.

- Activities will not cause turbidity increases in surface waters to exceed the following levels:

  > Where natural turbidity is between 0 and 5 NTUs, increases will not exceed 1 NTU. Where natural turbidity is between 5 and 50 NTUs, increases will not exceed 20 percent. Where natural turbidity is between 50 and 100 NTUs, increase will not exceed 10 NTUs. Where natural turbidity is greater than 100 NTUs, increases will not exceed 10 percent. These limits will be eased during in-water working periods to allow a turbidity increase of 15 NTU over background turbidity as measured in surface waters 300 feet downstream from the working area.

- In the event that project activities result in creation of a visible plume in surface waters, the project manager will initiate monitoring of turbidity levels at the discharge site and 300 feet downstream, taking grab samples for analysis of NTU levels twice per day during the work period while the visible plume persists.

- Activities will not cause settleable matter to exceed 0.1 ml/l in surface waters as measured in surface waters 300 feet downstream from the project.

- Activities will not cause visible oil, grease, or foam in the work area or downstream.

- All areas disturbed by project activities will be protected from washout or erosion.

- RD 108 will notify the Regional Board, CDFG, and NMFS immediately if the above criteria for turbidity, oil/grease, or foam are exceeded.

- RD 108 will notify the Regional Board, CDFG, and NMFS immediately of any spill of petroleum products or other organic or earthen materials.

4. Hazardous Materials Control and Spill Prevention and Response Plan

The construction contractor will be required to prepare and implement a hazardous materials control and spill prevention and response plan. The plan will be prepared by the construction contractor for the proposed project and should be implemented before the construction phase begins. The Regional Board, CDFG, NMFS, and the USFWS will review the plan to verify that hazardous material control and spill response measures have been incorporated to control the use of hazardous materials and reduce the chance of spills to the maximum extent practicable. The Regional Board, CDFG, NMFS, the USFWS and RD 108 will inspect construction activities to ensure compliance with this measure. Measures will include, but will not be limited to, the following:

- Preventing raw cement, concrete or concrete washings, asphalt, paint, or other coating material, oil or other petroleum products, or any other substances that could be hazardous to aquatic life from contaminating the soil or entering watercourses, including ditches and canals.

- Establishing a spill prevention and countermeasure plan before project construction that includes strict on-site handling rules to keep construction and maintenance materials out of drainage and waterways.

- Cleaning up all spills immediately according to the spill prevention and countermeasure plan, and notifying CDFG and the Regional Board immediately of spills and cleanup procedures.

- Providing staging and storage areas for equipment, materials, fuels, lubricants, solvents, and other possible contaminants away from watercourses and their watersheds.

5. Fish Rescue Program

Fish rescue will be conducted during the dewatering of the area behind the cofferdam. Rescuers will capture fish trapped within the cofferdam and relocate them to suitable habitat within the Sacramento River. A fisheries biologist will be present during the construction and dewatering activities to oversee the rescue program. NMFS will be notified a minimum of 48 hours in advance of the fish rescue and relocation.

6. Long-term Monitoring and Maintenance Plan

To ensure that the fish screen operates as intended and incidental mortality associated with diversions at the facility are in conformance with the goals and objectives of the project, long-term monitoring and maintenance of the fish screen will be conducted. Monitoring will include approach velocity measurements immediately after initiation of the positive barrier screen operations, with fine-tuning of velocity control baffles as necessary, to achieve uniformity of velocities in conformance with the CDFG and NMFS criteria (0.33 ft/sec). RD 108 also will monitor the condition of the positive barrier screen on an annual basis, and will do periodic visual inspections to remove accumulated debris and repair screen panels as necessary. NMFS and CDFG will have access to the positive barrier screen for underwater inspections following completion of intake screen construction. The standards for success will be long-term reliable operation of the fish screen, and conformance with intake screen design criteria.

F. Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The action area, for the purposes of this biological opinion, is located along approximately five miles of the Sacramento River from RM 105.7 to RM 111, and along approximately 5 miles of the RD 108 inland canal network. This area was selected because it represents the footprint of the action and the upstream and downstream extent of anticipated effects to listed salmonids of project actions including construction and operation of the new fish screen and pumping facilities at RM 110.3, and decommissioning activities at Boyers Bend (RM 111), Howells Landing (RM 109), and Tyndall Mound (RM 105.7).

III. STATUS OF THE SPECIES AND HABITAT

This biological opinion analyzes the effects of RD 108 Combined Pumping Plant and Fish Screen project on the following threatened and endangered species and designated critical habitat:

Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) - endangered
Sacramento River winter-run Chinook salmon - critical habitat
Central Valley spring-run Chinook salmon (*O. tshawytscha*) - threatened
Central Valley spring-run Chinook salmon - critical habitat
Central Valley steelhead (*O. mykiss*) - threatened
Central Valley steelhead - critical habitat

A. Species Life History, Population Dynamics, and Likelihood of Survival and Recovery

1. <u>Sacramento River winter-run Chinook salmon</u>

Sacramento River winter-run Chinook salmon originally were listed as threatened in November 1990 (55 FR 46515). Their status was reclassified as endangered in January 1994 (59 FR 440) due to continued decline and increased variability of run sizes since their listing as a threatened species, expected weak returns as a result of two small year classes in 1991 and 1993, and continued threats to the population. In the proposed rule to reclassify the winter-run Chinook salmon as endangered, NMFS recognized that the population had dropped nearly 99 percent between 1966 and 1991, and despite conservation measures to improve habitat conditions, the population continued to decline (57 FR 27416). In June 2004 NMFS proposed to reclassify Sacramento River winter-run Chinook salmon as threatened (69 FR 33102). This determination was based on three main points: (1) harvest and habitat conservation efforts have increased the abundance and productivity of the Evolutionarily Significant Unit (ESU) over the past decade; (2) artificial propagation programs that are part of the ESU, the Captive Broodstock Programs at

Livingston Stone National Fish Hatchery (LSNFH) and at the University of California Bodega Marine Laboratory contribute to the ESU's viability; and (3) CALFED ecosystem restoration plans underway in Battle Creek should provide the opportunity to establish a second winter-run Chinook salmon population. However, on June 28, 2005, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of Sacramento River winter-run Chinook salmon as endangered (70 FR 37160). This decision was based on the continued threats to Sacramento River winter-run Chinook salmon and the continued likelihood of this ESU becoming extinct throughout all or a significant portion of its range. A draft recovery plan was published in August 1997 (NMFS 1997).

Winter-run Chinook salmon historically spawned in the headwaters of the McCloud, Pit, and Little Sacramento Rivers and Hat and Battle Creeks. Construction of Shasta Dam in 1943 and Keswick Dam in 1950 blocked access to all of these waters except Battle Creek, which has been severely impacted by hydroelectric facilities and the Coleman National Fish Hatchery (Moyle *et al.* 1989; NMFS 1997). The majority of the current winter-run Chinook salmon spawning and rearing habitat exists on the mainstem Sacramento River between Keswick Dam and Red Bluff Diversion Dam (RBDD). Although a small, unknown, number of winter-run Chinook salmon occasionally spawn in Battle and Clear Creeks, the ESU is widely considered to be reduced to a single naturally spawning population in the mainstem Sacramento River below Keswick Dam.

Following the construction of Shasta Dam, the number of winter-run Chinook salmon initially declined but recovered during the 1960s. This initial recovery was followed by a steady decline from 1969 through the late 1980s (USFWS 1999).

Adult winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate past RBDD from mid-December through early August (NMFS 1997). The majority of the run passes RBDD from January through May, and peaks in mid-March (Hallock and Fisher 1985). Generally, winter-run Chinook salmon spawn from near Keswick dam downstream to Red Bluff, California. The largest concentrations of spawning fish occur in the first five to ten miles below Keswick Dam. Spawning occurs from late April through mid-August with peak activity between May and June. Eggs and pre-emergent fry require water temperatures at or below 56 ^{o}F for maximum survival during the spawning and incubation period (USFWS 1999). Fry emerge from mid-June through mid-October and move to river margins and tributary streams to rear. Emigration past RBDD may begin in mid-July and typically peaks in September and can continue through March in dry years (NMFS 1997, Vogel and Marine 1991). From 1995 to 1999, all winter-run Chinook salmon outmigrating as fry passed RBDD by October, and all outmigrating pre-smolts and smolts passed RBDD by March (Martin *et al.* 2001).

Construction of RBDD in 1966 enabled improved accuracy of population estimates as salmon passed through fish ladders. From 1967 to 2000, winter-run Chinook salmon estimates were extrapolated from adult counts at RBDD ladders. Recent operational changes at RBDD have allowed a majority of the winter-run Chinook salmon population to bypass the ladders and counting facilities, and has increased the error associated with extrapolating the population estimate. Beginning in 2001, carcass counts replaced the ladder count to reduce the error associated with the estimate.

Since 1967, the estimated adult winter-run Chinook salmon population ranged from 186 in 1994 to 117,808 in 1969 (CDFG 2002). The estimate declined from an average of 86,000 adults in 1967-1969 to only 2,000 by 1987-1989, and continued downward to an average 830 fish in 1994-1996. Since then, estimates have increased to an average of 3,136 fish for the period of 1998-2001. Winter-run abundance estimates and cohort replacement rates since 1986 are shown in Table 2. Although the population estimates display broad fluctuation since 1986 (186 in 1994 to 9,757 in 2003), there has been an increasing average population trend since 1995, and a generally stable trend in the five-year moving average of cohort replacement rates. The 2003 run was the highest since the listing, with an estimate of 9,757 adult fish.

Table 2. Winter-run Chinook salmon population estimates from RBDD counts, and corresponding cohort replacement rates for the years since 1986 (CDFG 2004a, Grand Tab February 2004).

Year	Population Estimate (RBDD)	5-Year Moving Average of Population Estimate	Cohort Replacement Rate	5-Year Moving Average of Cohort Replacement Rate
1986	2,596	-	-	-
1987	2,186	-	-	-
1988	2,885	-	-	-
1989	696	-	0.27	-
1990	433	1,759	0.20	-
1991	211	1,282	0.07	-
1992	1,240	1,092	1.78	-
1993	387	593	0.90	0.64
1994	186	491	0.88	0.77
1995	1,297	664	1.05	0.94
1996	1,337	889	3.45	1.61
1997	880	817	4.73	2.20
1998	3,002	1,340	2.31	2.48
1999	3,288	1,961	2.46	2.80
2000	1,352	1,972	1.54	2.90
2001	8,224	3,349	2.74	2.76
2002	7,441	4,661	2.26	2.22
2003	8,218	5,705	6.08	3.02
2004	7,701	6,587	0.94	2.71

2. Central Valley Spring-Run Chinook Salmon

NMFS listed the Central Valley spring-run Chinook salmon (CV spring-run Chinook salmon) ESU as threatened on September 16, 1999 (64 FR 50394). In June 2004, NMFS proposed that CV spring-run Chinook salmon remain listed as threatened (69 FR 33102). This proposal was based on the recognition that although CV spring-run Chinook salmon productivity trends are positive, the ESU continues to face risks from having a limited number of remaining metapopulations (*i.e.*, three existing populations from an estimated 17 historical populations), a limited geographic distribution, and potential hybridization with Feather River Hatchery (FRH) spring-run Chinook salmon, which until recently were not included in the ESU and are genetically divergent from other metapopulations in Mill, Deer, and Butte Creeks. On June 28, 2005, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of CV spring-run Chinook salmon as threatened (70 FR 37160). This decision also included the FRH spring-run Chinook salmon population as part of the CV spring-run Chinook salmon ESU.

The decision to include the FRH population was based on several factors: (1) FRH spring-run Chinook salmon are no more divergent from the naturally spawning population in the Feather River than would be expected between two closely related populations in the ESU; (2) NMFS believes the early run timing of spring-run Chinook salmon in the Feather River represents the evolutionary legacy of the populations that once spawned above Oroville Dam, and that the extant population in the Feather River may be the only remaining representative of this ESU component; (3) the California Department of Water Resources (CDWR) is planning to construct a weir to create geographic isolation for spring-run Chinook in the Feather River to minimize future hybridization with fall-run Chinook salmon, and to preserve the early run timing phenotype, and (4) the FHR spring-run Chinook salmon may play an important role in the recovery of spring-run Chinook salmon populations in the Feather and Yuba Rivers.

Historically, spring-run Chinook salmon were the dominant run in the Sacramento River basin, occupying the middle and upper elevation reaches (1,000 to 6,000 feet) of most streams and rivers with sufficient habitat for over-summering adults (Clark 1929). Clark estimated that there were 6,000 miles of salmon habitat in the Central Valley basin (much of which was high elevation spring-run Chinook salmon habitat) and that by 1928, 80 percent of this habitat had been lost. Yoshiyama *et al.* (1996) determined that, historically, there were approximately 2,000 miles of salmon habitat available prior to dam construction and mining and that only 18 percent of that habitat remains.

Adult CV spring-run Chinook salmon enter the Sacramento-San Joaquin Delta (Delta) from the Pacific Ocean beginning in January and enter natal streams from March to July. In Mill Creek, Van Woert (1964) noted that of 18,290 CV spring-run Chinook salmon observed from 1953 to 1963, 93.5 percent were counted between April 1 and July 14, and 89.3 percent were counted between April 29 and June 30.

During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows also are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38 °F to 56 °F (Bell 1991, CDFG 1998).

Upon entering fresh water, spring-run Chinook salmon are sexually immature and must hold in cold water for several months to mature. Typically, spring-run Chinook salmon utilize mid- to high-elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering. Spring-run Chinook salmon also may utilize tailwaters below dams if cold-water releases provide suitable habitat conditions. Spawning occurs between September and October and, depending on water temperature, emergence occurs between November and February.

CV spring-run Chinook salmon emigration is highly variable (CDFG 1998). Some may begin outmigrating soon after emergence, whereas others oversummer and emigrate as yearlings with the onset of increased fall storms (CDFG 1998). The emigration period for CV spring-run Chinook salmon extends from November to early May, with up to 69 percent of young-of-the-year outmigrants passing through the lower Sacramento River between mid-November and early January (Snider and Titus 2000). Outmigrants also are known to rear in non-natal tributaries to the Sacramento River and the Delta (CDFG 1998).

Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers *et al.* 1998). Fisher (1994) reported that 87 percent of Chinook salmon trapped and examined at RBDD between 1985 and 1991 were three-year olds.

Spring-run Chinook salmon were once the most abundant run of salmon in the Central Valley (Campbell and Moyle 1992) and were found in both the Sacramento and San Joaquin drainages. More than 500,000 CV spring-run Chinook salmon were caught in the Sacramento-San Joaquin commercial fishery in 1883 alone (Yoshiyama *et al.* 1998). The San Joaquin populations were essentially extirpated by the 1940s, with only small remnants of the run that persisted through the 1950s in the Merced River (Hallock and Van Woert 1959, Yoshiyama *et al.* 1998). Populations in the upper Sacramento, Feather, and Yuba Rivers were eliminated with the construction of major dams during the1950s and 1960s. Naturally spawning populations of CV spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Mill Creek, Feather River, and the Yuba River (CDFG 1998).

Since 1969, the CV spring-run Chinook salmon ESU has displayed broad fluctuations in abundance, ranging from 1,403 in 1993 to 25,890 in 1982 (CDFG 2004a). The average abundance for the ESU was 12,590 for the period of 1969 to 1979, 13,334 for the period of 1980 to 1990, and 6,554 from 1991 to 2001. Evaluating the abundance of the ESU as a whole, however, complicates trend detection. For example, although the mainstem Sacramento River population appears to have undergone a significant decline, the data are not necessarily comparable because coded wire tag (CWT) information gathered from fall-run Chinook salmon returns since the early 1990s has resulted in adjustments to ladder counts at RBDD that have reduced the overall number of fish that are categorized as CV spring-run Chinook salmon (Colleen Harvey-Arrison, CDFG, pers. comm., 2003).

Sacramento River tributary populations in Mill, Deer, and Butte Creeks are probably the best trend indicators for the CV spring-run Chinook ESU as a whole. Table 3 shows the population trends from these tributaries since 1986, including the moving 5 year average and cohort replacement rate. Generally, these streams have shown a positive escapement trend since 1991. Escapement numbers are dominated by Butte Creek returns, including 20,259 in 1998, 9,605 in 2001, 8,785 in 2002, 4,398 in 2003, and 7,390 in 2004 (CDFG 2002, 2003, CDFG 2004a). Although recent trends are positive, annual abundance estimates display a high level of fluctuation, and the overall number of CV spring-run Chinook salmon remains well below estimates of historic abundance. Additionally, in 2003, high water temperatures, high fish densities, and an outbreak of Columnaris Disease (*Flexibacter Columnaris*) and Ichthyophthiriasis (*Ichthyophthirius multifiis*) contributed to the pre-spawning mortality of an estimated 11,231 adult spring-run Chinook salmon in Butte Creek. Because the CV spring-run Chinook salmon ESU is confined to relatively few remaining streams; continues to display broad fluctuations in abundance; and a large proportion of the population (i.e., in Butte Creek) faces the risk of high mortality rates, the population is at a moderate to high risk of extinction.

Table 3. Spring-run Chinook salmon population estimates from Mill, Deer, and Butte Creeks since 1986 (CDFG 2004a, Grand Tab February 2004).

Year	Deer/Mill/Butte Creek Escapement Run Size	5-Year Moving Average of Population Estimate	Cohort Replacement Rate	5-Year Moving Average of Cohort Replacement Rate
1986	2,205	-	-	-
1987	304	-	-	-
1988	2,233	-	-	-
1989	1,947	-	0.29	-
1990	1,590	12,383	0.46	-
1991	798	7,855	0.13	-
1992	1,176	5,629	0.22	-
1993	970	3,490	0.24	0.27
1994	1,682	2,582	1.57	0.52
1995	9,115	3,389	6.35	1.70
1996	2,280	3,604	1.93	2.0.6
1997	1,301	3,581	0.56	2.13
1998	22,562	8,245	2.52	2.58
1999	5,830	8,950	2.25	2.72
2000	5,299	8,077	3.81	2.21
2001	12,331	10,202	0.54	1.94
2002	12,564	12,559	2.18	2.26
2003	8,583	9,9394	1.63	2.08
2004	9,872	10,155	0.74	1.78

3. Central Valley Steelhead

NMFS listed the Central Valley steelhead (CV steelhead) ESU as threatened on March 19, 1998 (63 FR 13347). The ESU includes all naturally-produced CV steelhead in the Sacramento-San Joaquin River basin. NMFS published a final 4(d) rule for steelhead on July 10, 2000 (65 FR 42422). The 4(d) rule applies the section 9 take prohibitions to threatened species except in cases where the take is associated with State and local programs that are approved by NMFS. In June 2004 NMFS proposed that CV steelhead remain listed as threatened (69 FR 33102). This proposal is based on the recognition that although the NMFS Biological Review Team (BRT) (NMFS 2003) found the ESU "in danger of extinction," ongoing protective efforts for this ESU, and the likely implementation of an ESU-wide monitoring program effectively counter this finding. NMFS also is proposing changes involving steelhead hatchery populations (69 FR 31354). The Coleman National Fish Hatchery and FRH steelhead populations are proposed for inclusion in the listed population of steelhead. These populations previously were included in the ESU but were not deemed essential for conservation and thus not part of the listed steelhead population. Finally, NMFS has proposed to include resident *Oncorhynchus mykiss,* present below natural or long-standing artificial barriers, in all steelhead ESUs (69 FR 33102). The final decisions on these steelhead proposals have been deferred for six months for further scientific review (70 FR 37160).

All steelhead stocks in the Central Valley are winter-run steelhead (McEwan and Jackson 1996). Steelhead are similar to Pacific salmon in their life history requirements. They are born in fresh water, emigrate to the ocean, and return to freshwater to spawn. Unlike other Pacific salmon, steelhead are capable of spawning more than once before they die.

The majority of the CV steelhead spawning migration occurs from October through February and spawning occurs from December to April in streams with cool, well oxygenated water that is available year round. Van Woert (1964) and Harvey (1995) observed that in Mill Creek, the CV steelhead migration is continuous, and although there are two peak periods, sixty percent of the run is passed by December 30. Similar bimodal run patterns have also been observed in the Feather River (Brad Cavallo, CDWR, pers. comm., 2002) and the American River (John Hannon, BOR, pers. comm., 2002).

Incubation time is dependent upon water temperature. Eggs incubate for one and a half to four months before emerging. Eggs held between 50 °F and 59 °F hatch within three to four weeks (Moyle 1976). Fry emerge from redds within in about four to six weeks depending on redd depth, gravel size, siltation, and temperature (Shapovalov and Taft 1954). Newly emerged fry move to shallow stream margins to escape high water velocities and predation (Barnhart 1986). As fry grow larger they move into riffles and pools and establish feeding locations. Juveniles rear in freshwater for one to four years (Meehan and Bjornn 1991) emigrating episodically from natal streams during fall, winter and spring high flows (Colleen Harvey Arrison, CDFG, pers. comm. 1999). Steelhead typically spend two years in fresh water. Adults spend one to four years at sea before returning to freshwater to spawn as four or five year olds (Moyle 1976).

Steelhead historically were well-distributed throughout the Sacramento and San Joaquin Rivers (Busby *et al.* 1996). Steelhead were found from the upper Sacramento and Pit River systems south to the Kings and possibly the Kern River systems and in both east- and west-side Sacramento River tributaries (Yoshiyama *et al.* 1996). The present distribution has been greatly reduced (McEwan and Jackson 1996). The California Advisory Committee on Salmon and Steelhead (1988) reported a reduction of steelhead habitat from 6,000 miles historically to 300 miles. The California Fish and Wildlife Plan (CDFG 1965) estimated there were 40,000 steelhead in the early 1950s. Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River, upstream of the Feather River.

Nobriga and Cadrett (2003) compared CWT and untagged (wild) steelhead smolt catch ratios at Chipps Island trawl from 1998-2001 to estimate that about 100,000 to 300,000 steelhead juveniles are produced naturally each year in the Central Valley. In the draft *Updated Status Review of West Coast Salmon and Steelhead* (NMFS 2003), the BRT made the following conclusion based on the Chipps Island data:

> "If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1 percent of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire Central Valley. This can be compared with McEwan's (2001) estimate of 1 million to 2 million spawners before 1850, and 40,000 spawners in the 1960s."

The only consistent data available on wild steelhead numbers in the San Joaquin River basin come from CDFG mid-water trawling samples collected on the lower San Joaquin River at Mossdale. These data indicate a decline in steelhead numbers in the early 1990s, which have remained low through 2002 (CDFG 2003). In 2003, a total of only 12 steelhead smolts were collected at Mossdale (CDFG, unpublished data).

Existing wild steelhead stocks in the Central Valley mostly are confined to upper Sacramento River and its tributaries, including Antelope, Deer, and Mill Creeks, and the Yuba River. Populations may exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996). Until recently, CV steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected populations of steelhead in the Stanislaus, Mokelumne, and Calaveras Rivers, and other streams previously thought to be void of steelhead (McEwan 2001). According to the findings of the Interagency Ecological Program Steelhead Project Work Team (IEP SPWT 1999), naturally spawning populations may exist in many other streams but are undetected due to lack of monitoring programs.

Reliable estimates of CV steelhead abundance for different basins are not available (McEwan 2001); however, McEwan and Jackson (1996) estimate the total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults. Steelhead counts at the RBDD have declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the 1990s (McEwan and Jackson 1996, McEwan 2001). The future of CV steelhead is uncertain because of the lack of status and trend data.

B. Habitat Condition and Function for Species' Conservation

Critical habitat for winter-run Chinook salmon was designated on June 16, 1993, and includes the Sacramento River from Keswick Dam (RM 302) downstream to Chipps Island (RM O) at the westward margin of the Delta; all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of the San Francisco Bay (north of the San Francisco Bay Bridge) from San Pablo Bay to the Golden Gate Bridge. The critical habitat designation identifies those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration or protection. Within the Sacramento River this includes the river water, river bottom (including those areas and associated gravel used by winter-run Chinook salmon as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing.

Critical Habitat for CV spring-run Chinook salmon and CV steelhead was designated on Septembter 2, 2005 (70 FR 52488). Critical habitat includes stream channels within certain occupied stream reaches and includes a lateral extent as defined by the ordinary high water mark (33 CFR 329.11) or the bankfull elevation. Critical habitat in estuarine reaches is defined by the perimeter of the water body or the elevation of the extreme high water mark, whichever is greater. The reach of the Sacramento River that contains the action area is designated critical habitat for Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead.

The freshwater habitat of salmon and steelhead in the Central Valley varies in function depending on location. Spawning areas are located in accessible, upstream reaches of the Sacramento or San Joaquin Rivers and their watersheds where viable spawning gravels and water conditions are found. Spawning habitat condition is strongly affected by water flow and quality, especially temperature, dissolved oxygen, and silt load, all of which can greatly affect the survival of eggs and larvae.

Migratory corridors are downstream of the spawning area and include the Delta. These corridors allow the upstream passage of adults, and the downstream emigration of outmigrant juveniles. Migratory habitat condition is strongly affected by the presence of barriers, which can include dams, unscreened or poorly screened diversions, and degraded water quality.

Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River and Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]). However, the channelized, leveed, and rip-rapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators.

C. Factors Affecting the Species and Habitat

A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species in the Central Valley. For example, NMFS prepared range-wide status reviews for west coast Chinook salmon (Myers *et al.* 1998) and steelhead (Busby *et al.* 1996). Also, the NMFS BRT published a draft updated status review for west coast Chinook salmon and steelhead in November 2003 (NMFS 2003). Information also is available in Federal Register notices announcing ESA listing proposals and determinations for some of these species and their critical habitat (*e.g.*, 58 FR 33212; 59 FR 440; 62 FR 24588; 62 FR 43937; 63 FR 13347; 64 FR 24049; 64 FR 50394; 65 FR 7764). The Final Programmatic Environmental Impact Statement/Report (EIS/EIR) for the CALFED Bay-Delta Program (CALFED 1999) and the Department of the Interior's (DOI) Final Programmatic EIS for the Central Valley Project Improvement Act (CVPIA) (DOI 1999) provide summaries of historical and recent environmental conditions for salmon and steelhead in the Central Valley. The following general description of the factors affecting the viability of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CV steelhead is based on a summarization of these documents.

In general, the human activities that have affected the listed anadromous salmonids and their habitats addressed in this opinion consist of: (1) dam construction that blocks previously accessible habitat; (2) water development and management activities that affect water quantity, flow timing, and quality; (3) land use activities such as agriculture, flood control, urban development, mining, road construction, and logging that degrade aquatic and riparian habitat; 4) hatchery operation and practices; (5) harvest activities; (6) predation; and (7) ecosystem restoration actions.

1. Habitat Blockage

Hydropower, flood control, and water supply dams of the CVP, State Water Project (SWP), and other municipal and private entities have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. Clark (1929) estimated that originally there were 6,000 miles of salmon habitat in the Central Valley system and that 80 percent of this habitat had been lost by 1928. Yoshiyama *et al.* (1996) calculated that roughly 2,000 miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent is not accessible today.

In general, large dams on every major tributary to the Sacramento River, San Joaquin River, and the Delta block salmon and steelhead access to the upper portions of the respective watersheds. On the Sacramento River, Keswick Dam blocks passage to historic spawning and rearing habitat in the upper Sacramento, McCloud, and Pit Rivers. Whiskeytown Dam blocks access to the upper watershed of Clear Creek. Oroville Dam and associated facilities block passage to the upper Feather River watershed. Nimbus Dam blocks access to most of the American River basin. Friant Dam construction in the mid-1940s has been associated with the elimination of spring-run Chinook salmon in the San Joaquin River upstream of the Merced River (DOI 1999). On the Stanislaus River, construction of New Melones Dam and Goodwin Dam blocked both spring and fall-run Chinook salmon (CDFG 2001).

As a result of the dams, Sacramento River winter-run Chinook salmon, CV Chinook salmon, and CV steelhead populations on these rivers have been confined to lower elevation mainstems that historically only were used for migration. Population abundances have declined in these streams due to decreased quantity and quality of spawning and rearing habitat. Higher temperatures at these lower elevations during late-summer and fall are a major stressor to adults and juvenile salmonids.

The Suisun Marsh Salinity Control Gates (SMSCG), located on Montezuma Slough, were installed in 1988, and are operated with gates and flashboards to decrease the salinity levels of managed wetlands in Suisun Marsh. The SMSCG have delayed or blocked passage of adult Chinook salmon migrating upstream (Edwards *et al.* 1996, Tillman *et al.* 1996).

2. Water Development

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted stream flows and altered the natural cycles by which juvenile and adult salmonids base their migrations. Depleted flows have contributed to higher temperatures, lower dissolved oxygen levels, and decreased recruitment of gravel and large woody debris (LWD). Furthermore, more uniform year-round flows have resulted in diminished natural channel formation, altered foodweb processes, and slower regeneration of riparian vegetation. These stable flow patterns have reduced bedload movement (Ayers 2001) and caused spawning gravels to become embedded and reduced channel width, which has decreased the available spawning and rearing habitat below dams.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the Central Valley. Hundreds of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, and their tributaries. Although efforts have been made in recent years to screen some of these diversions, many remain unscreened. Depending on the size, location, and season of operation, these unscreened intakes entrain and kill many life stages of aquatic species, including juvenile salmonids. For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). Most of the 370 water diversions operating in Suisun Marsh are unscreened (USFWS 2003).

Outmigrant juvenile salmonids in the Delta have been subjected to adverse environmental conditions created by water export operations at the CVP/SWP. Specifically, juvenile salmonid survival has been reduced from: (1) water diversion from the mainstem Sacramento River into the Central Delta via the Delta Cross Channel; (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; (3) entrainment at the CVP/SWP export facilities and associated problems at Clifton Court Forebay; and (4) increased exposure to introduced, non-native predators such as striped bass (*Morone saxatilis*), largemouth bass (*Micropterus salmoides*), and American shad (*Alosa sapidissima*).

The consultation for the CVP operations, criteria, and plan (OCAP) was completed with the issuance of a biological opinion by NMFS on October 22, 2004. The OCAP biological opinion found that CVP and SWP actions are likely to adversely affect Federally listed Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead, and the critical habitat of winter-run Chinook salmon, due to reservoir releases, Sacramento River flows, water temperatures, and physical facility operations that reduce habitat availability and suitability. These effects are expected to impact and result in the take of individual fish by delaying or blocking adult migration into suitable spawning habitat and decreasing spawning success, killing vulnerable life stages such as eggs, larvae, and juveniles due to stranding or elevated water temperatures, or increasing the likelihood of disease or juvenile vulnerability to predation due to temperature stress. NMFS determined that these effects are not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, or CV steelhead, and are not likely to destroy or adversely modify their designated critical habitat.

3. Land Use Activities

Land use activities continue to have large impacts on salmonid habitat in the Central Valley. Until about 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation extending outward for four or five miles (California Resources Agency 1989). By 1979, riparian habitat along the Sacramento River had diminished to 11,000 to 12,000 acres, or about 2 percent of historic levels (McGill 1987). The degradation and fragmentation of riparian habitat had resulted mainly from flood control and bank protection projects, together with the conversion of riparian land to agriculture (Jones and Stokes Associates, Incorporated 1993).

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is a primary cause of salmonid habitat degradation (NMFS 1996). Sedimentation can adversely affect salmonids during all freshwater life stages by; clogging, or abrading gill surfaces, adhering to eggs, and restricting fry emergence (Phillips and Campbell 1961); burying eggs or alevins; scouring and filling in pools and riffles; reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961); and affecting intergravel permeability and dissolved oxygen levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning, and egg and fry survival (Hartmann *et al.* 1987).

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWD; and removal of riparian vegetation resulting in increased streambank erosion (Meehan and Bjornn 1991). Agricultural practices in the Central Valley have eliminated large trees and logs and other woody debris that would otherwise be recruited into the stream channel (NMFS 1998). LWD influences stream morphology by affecting channel pattern, position, and geometry, as well as pool formation (Keller and Swanson 1979, Bilby 1984, Robison and Beschta 1990).

Since the 1850s, wetlands reclamation for urban and agricultural development has caused the cumulative loss of 79 and 94 percent of the tidal marsh habitat in the Delta downstream and upstream of Chipp's Island, respectively (Goals Project 1999). In Suisun Marsh, salt water intrusion and land subsidence gradually has led to the decline of agricultural production. Presently, Suisun Marsh consists largely of tidal sloughs and managed wetlands for duck clubs.

Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges. Studies by CDWR on water quality in the Delta over the last 30 years show a steady decline in the food sources available for juvenile salmonids and an increase in the clarity of the water. These conditions likely have contributed to increased mortality of juvenile Chinook salmon and steelhead as they move through the Delta.

4. Hatchery Operations and Practices

Five hatcheries currently produce Chinook salmon in the Central Valley and four of these also produce steelhead. Releasing large numbers of hatchery fish can pose a threat to wild Chinook salmon and steelhead stocks through genetic impacts, competition for food and other resources between hatchery and wild fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs in the Central Valley primarily are caused by straying of hatchery fish and the subsequent interbreeding of hatchery fish with wild fish. In the Central Valley, practices such as transferring eggs between hatcheries and trucking smolts to distant sites for release contribute to elevated straying levels (DOI 1999). For example, Nimbus Hatchery on the American River rears Eel River steelhead stock and releases these fish in the Sacramento River.

Hatchery practices as well as spatial and temporal overlaps of habitat use and spawning activity between spring- and fall-run fish have led to the hybridization and homogenization of some subpopulations (CDFG 1998). As early as the 1960s, Slater (1963) observed that early fall- and spring-run Chinook salmon were competing for spawning sites in the Sacramento River below Keswick Dam, and speculated that the two runs may have hybridized. FRH spring-run Chinook salmon have been documented as straying throughout the Central Valley for many years (CDFG 1998), and in many cases have been recovered from the spawning grounds of fall-run Chinook salmon (Colleen Harvey-Arrison and Paul Ward, CDFG, pers. comm., 2002), an indication that FRH spring-run Chinook salmon may exhibit fall-run life history characteristics. Although the degree of hybridization has not been comprehensively determined, it is clear that the populations of spring-run Chinook salmon spawning in the Feather River and counted at RBDD contain hybridized fish.

The management of hatcheries, such as Nimbus Hatchery and FRH, can directly impact CV spring-run Chinook salmon and CV steelhead populations by overproducing the natural capacity of the limited habitat available below dams. In the case of the Feather River, significant redd superimposition occurs in-river due to hatchery overproduction and the inability to physically separate CV spring-run and fall-run Chinook salmon adults. This concurrent spawning has led to hybridization between the spring- and fall-run Chinook salmon in the Feather River. At Nimbus Hatchery, operating Folsom Dam to meet temperature requirements for returning hatchery fall-run Chinook salmon often limits the amount of water available for steelhead spawning and rearing the rest of the year.

The increase in Central Valley hatchery production has reversed the composition of the steelhead population, from 88 percent naturally-produced fish in the 1950s (McEwan 2001) to an estimated 23 to 37 percent naturally-produced fish currently (Nobriga and Cadrett 2001). The increase in hatchery steelhead production proportionate to the wild population has reduced the viability of the wild steelhead populations, increased the use of out-of-basin stocks for hatchery production, and increased straying (NMFS 2001). Thus, the ability of natural populations to successfully reproduce has likely been diminished.

The relatively low number of spawners needed to sustain a hatchery population can result in high harvest-to-escapements ratios in waters where regulations are set according to hatchery population. This can lead to over-exploitation and reduction in size of wild populations coexisting in the same system (McEwan 2001).

Hatcheries also can have some positive effects on salmonid populations. Artificial propagation has been shown effective in bolstering the numbers of naturally spawning fish in the short term under certain conditions, and in conserving genetic resources and guarding against catastrophic loss of naturally spawned populations at critically low abundance levels, such as Sacramento River winter-run Chinook salmon. However, relative abundance is only one component of a viable salmonid population.

5. Ocean and Sport Harvest

Extensive ocean recreational and commercial troll fisheries for Chinook salmon exist along the Central California coast, and an inland recreational fishery exists in the Central Valley for Chinook salmon and steelhead. Ocean harvest of Central Valley Chinook salmon is estimated using an abundance index, called the Central Valley Index (CVI). The CVI is the ratio of Chinook salmon harvested south of Point Arena (where 85 percent of Central Valley Chinook salmon are caught) to escapement. CWT returns indicate that Sacramento River salmon congregate off the coast between Point Arena and Morro Bay.

Historically in California, almost half of the river sportfishing effort was in the Sacramento-San Joaquin River system, particularly upstream from the city of Sacramento (Emmett *et al.* 1991). Since 1987, the Fish and Game Commission has adopted increasingly stringent regulations to reduce and virtually eliminate the in-river sport fishery for winter-run Chinook salmon. Present regulations include a year-round closure to Chinook salmon fishing between Keswick Dam and the Deschutes Road Bridge and a rolling closure to Chinook salmon fishing on the Sacramento River between the Deschutes River Bridge and the Carquinez Bridge. The rolling closure spans the months that migrating adult winter-run Chinook salmon are ascending the Sacramento River to their spawning grounds. These closures have virtually eliminated impacts on winter-run Chinook salmon caused by recreational angling in freshwater. In 1992, the California Fish and Game Commission adopted gear restrictions (all hooks must be barbless and a maximum of 5.7 cm in length) to minimize hooking injury and mortality of winter-run Chinook salmon caused by trout anglers.

In-river recreational fisheries historically have taken CV spring-run Chinook salmon throughout the species' range. During the summer, holding adult CV spring-run Chinook salmon are easily targeted by anglers when they congregate in large pools. Poaching also occurs at fish ladders, and other areas where adults congregate; however, the significance of poaching on the adult population is unknown. Specific regulations for the protection of CV spring-run Chinook salmon in Mill, Deer, Butte and Big Chico Creeks were added to the existing CDFG regulations in 1994. The current regulations, including those developed for winter-run Chinook salmon, provide some level of protection for CV spring-run Chinook salmon (CDFG 1998).

There is little information on steelhead harvest rates in California. Hallock *et al.* (1961) estimated that harvest rates for Sacramento River steelhead from the 1953-54 through 1958-59 seasons ranged from 25.1 percent to 45.6 percent assuming a 20 percent non-return rate of tags. Staley (1975) estimated the harvest rate in the American River during the 1971-1972 and 1973-74 seasons to be 27 percent. The average annual harvest rate of adult steelhead above RBDD for the three-year period from 1991-92 through 1993-94 was 16 percent (McEwan and Jackson 1996). Since 1998, all hatchery steelhead have been marked with an adipose fin clip allowing anglers to distinguish hatchery and wild steelhead. Current regulations restrict anglers from keeping unmarked steelhead in Central Valley streams (CDFG 2004b). Overall, this regulation has greatly increased protection of naturally produced adult CV steelhead.

6. <u>Predation</u>

Accelerated predation also may be a factor in the decline of winter-run Chinook salmon and CV spring-run Chinook salmon, and to a lesser degree CV steelhead. Additionally, human-induced habitat changes such alteration of natural flow regimes and installation of bank revetment and structures such as dams, bridges, water diversions, piers, and wharves often provide conditions that both disorient juvenile salmonids and attract predators (Stevens 1961, Decato 1978, Vogel *et al.* 1988, Garcia 1989).

On the mainstem Sacramento River, high rates of predation are known to occur at RBDD, Anderson Cottonwood Irrigation District, and Glenn Colusa Irrigation District, areas where rock revetment has replaced natural river bank vegetation, and at south Delta water diversion structures (*e.g.*, Clifton Court Forebay; CDFG 1998). Predation at RBDD on juvenile winter-run Chinook salmon is believed to be higher than normal due to factors such as water quality and flow dynamics associated with the operation of this structure. Due to their small size, early emigrating winter-run Chinook salmon may be very susceptible to predation in Lake Red Bluff when the RBDD gates remain closed in summer and early fall (Vogel *et al.* 1988). In passing the dam, juveniles are subject to conditions which greatly disorient them, making them highly susceptible to predation by fish or birds. Sacramento pikeminnow (*Ptychocheilus grandis*) and striped bass congregate below the dam and prey on juvenile salmon.

USFWS found that more predatory fish were found at rock revetment bank protection sites between Chico Landing and Red Bluff than at sites with naturally eroding banks (Michny and Hampton 1984). From October 1976 to November 1993, CDFG conducted 10 mark/recapture experiments at the SWP's Clifton Court Forebay to estimate pre-screen losses using hatchery-reared juvenile Chinook salmon. Pre-screen losses ranged from 69 percent to 99 percent. Predation from striped bass is thought to be the primary cause of the loss (Gingras 1997).

Other locations in the Central Valley where predation is of concern include flood bypasses, release sites for salmonids salvaged at the State and Federal fish facilities, and the SMSCG. Predation on salmon by striped bass and pikeminnow at salvage release sites in the Delta and lower Sacramento River has been documented (Orsi 1967; Pickard *et al.* 1982). Predation rates at these sites are difficult to determine. CDFG conducted predation studies from 1987-1993 at the SMSCG to determine if the structure attracts and concentrates predators. The dominant predator species at the structure was striped bass, and juvenile Chinook salmon were identified in their stomach contents (NMFS 1997).

7. Ecosystem Restoration

a. *CALFED*

Two programs under CALFED, the ERP and the Environmental Water Account (EWA), were created to improve conditions for fish, including listed salmonids, in the Central Valley. Restoration actions implemented by the ERP include the installation of fish screens, modification of barriers to improve fish passage, habitat acquisition, and instream habitat restoration. The majority of these recent actions address key factors affecting listed salmonids, and emphasis has been placed in tributary drainages with high potential for CV steelhead and CV spring-run Chinook salmon production. Additional ongoing actions include new efforts to enhance fisheries monitoring and directly support salmonid production through hatchery releases. Recent habitat restoration initiatives sponsored and funded primarily by the CALFED-ERP program have resulted in plans to restore ecological function to 9,543 acres of shallow-water tidal and marsh habitats within the Delta. Restoration of these areas primarily involves flooding lands previously used for agriculture, thereby creating additional rearing habitat for juvenile salmonids. Similar habitat restoration is imminent adjacent to Suisun Marsh (*i.e.*, at the confluence of Montezuma Slough and the Sacramento River) as part of the Montezuma Wetlands project, which is intended to provide for commercial disposal of material dredged from San Francisco Bay in conjunction with tidal wetland restoration.

A sub-program of the ERP called the Environmental Water Program has been established to support ERP projects through enhancement of instream flows that are biologically and ecologically significant. This program is in the development stage and the benefits to listed salmonids are not yet clear. Clear Creek is one of five watersheds in the Central Valley that has been targeted for action during Phase I of this program.

The EWA is geared to providing water at critical times to meet ESA requirements and incidental take limits without water supply impacts to other users. In early 2001, EWA released 290,000 acre-feet of water at key times to offset reductions in south Delta pumping to protect winter-run Chinook salmon, and other Delta fish species. The actual number of fish saved was very small. The anticipated benefits to fisheries from EWA were much higher than what has actually occurred.

b. *CVPIA*

The CVPIA implemented in 1992 requires that fish and wildlife get equal consideration with water allocations from the CVP. From this act arose two programs that benefit listed salmonids: the Anadromous Fish Restoration Program (AFRP) and the Water Acquisition Program (WAP). The AFRP has engaged in monitoring, education, and restoration projects geared toward recovery of all anadromous fish species residing in the Central Valley. Restoration projects funded through the AFRP include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment. The goal of the WAP is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the DOI's ability to meet regulatory water quality requirements. Water has been used successfully to improve fish habitat for CV spring-run Chinook salmon and CV steelhead by maintaining or increasing instream flows in Butte and Mill Creeks and the San Joaquin River at critical times.

c. *Iron Mountain Mine Remediation*

The Environmental Protection Agency's (EPA) Iron Mountain Mine remediation involves the removal of toxic metals in acidic mine drainage from the Spring Creek Watershed with a state-of-the-art lime neutralization plant. Contaminant loading into the Sacramento River from Iron Mountain Mine has shown measurable reductions since the early 1990s. Decreasing the heavy metal contaminants that enter the Sacramento River should increase the survival of salmonid eggs and juveniles. However, during periods of heavy rainfall upstream of the Iron Mountain Mine, BOR substantially increases Sacramento River flows in order to dilute heavy metal contaminants being spilled from Spring Creek debris dam. This rapid change in flows can cause juvenile salmonids to become stranded or isolated in side channels below Keswick Dam.

d. *SWP Delta Pumping Plant Fish Protection Agreement (Four-Pumps Agreement)*

The Four Pumps Agreement Program has approved about $49 million for projects that benefit salmon and steelhead production in the Sacramento-San Joaquin basins and Delta since the agreement inception in 1986. Four Pumps projects that benefit CV spring-run Chinook salmon and CV steelhead include water exchange programs on Mill and Deer Creeks; enhanced law enforcement efforts from San Francisco Bay upstream to the Sacramento and San Joaquin Rivers and their tributaries; design and construction of fish screens and ladders on Butte Creek; and screening of diversions in Suisun Marsh and San Joaquin tributaries. Predator habitat isolation and removal, and spawning habitat enhancement projects on the San Joaquin tributaries benefit CV steelhead.

The Spring-run Salmon Increased Protection project provides overtime wages for CDFG wardens to focus on reducing illegal take and illegal water diversions on upper Sacramento River tributaries and adult holding areas, where the fish are vulnerable to poaching. This project covers Mill, Deer, Antelope, Butte, Big Chico, Cottonwood, and Battle Creeks, and has been in effect since 1996. Through the Delta-Bay Enhanced Enforcement Program, initiated in 1994, a team of 10 wardens focus their enforcement efforts on salmon, steelhead, and other species of concern from the San Francisco Bay Estuary upstream into the Sacramento and San Joaquin River basins. These two enhanced enforcement programs, in combination with additional concern and attention from local landowners and watershed groups on the Sacramento River tributaries which support CV spring-run Chinook salmon summer holding habitat, have been shown to reduce the amount of poaching in these upstream areas.

The provisions of funds to cover over-budget costs for the Durham Mutual/Parrot Phelan Screen and Ladders project expedited completion of the construction phase of this project which was completed during 1996. The project continues to benefit salmon and steelhead by facilitating upstream passage of adult spawners and downstream passage of juveniles.

The Mill and Deer Creek Water Exchange projects are designed to provide new wells that enable diverters to bank groundwater in place of stream flow, thus leaving water in the stream during critical migration periods. On Mill Creek several agreements between Los Molinos Mutual Water Company (LMMWC), Orange Cove Irrigation District (OCID), CDFG, and CDWR allows CDWR to pump groundwater from two wells into the LMMWC canals to pay back LMMWC water rights for surface water released downstream for fish. Although the Mill Creek Water Exchange project was initiated in 1990 and the agreement was for a well capacity of 25 cfs, only 12 cfs has been developed to date (BOR and OCID 1999). In addition, it has been determined that a base flow of greater than 25 cfs is needed during the April through June period for upstream passage of adult CV spring-run Chinook salmon in Mill Creek (BOR and OCID 1999). In some years, water diversions from the creek are curtailed by amounts sufficient to provide for passage of upstream migrating adult CV spring-run Chinook salmon and downstream migrating juvenile CV steelhead and CV spring-run Chinook salmon. However, the current arrangement does not ensure adequate flow conditions will be maintained in all years. CDWR, CDFG, and USFWS have developed the Mill Creek Adaptive Management Enhancement Plan to address the instream flow issues. A pilot project using one of the 10 pumps originally proposed for Deer Creek was tested in summer 2003. Future testing is planned with implementation to follow.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the status of the species within the action area. The environmental baseline "includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR §402.02).

A. Status of the Species and Habitat in the Action Area

The entire action area lies within designated critical habitat of the Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon and CV steelhead. The action area is within a reach of the mainstem Sacramento River that is confined by levees, protected by rock riprap, and lined with sparse amounts of Shaded Riverine Aquatic (SRA) cover. The essential habitat elements in the action area are the water, substrate, and SRA cover.

1. Status of the Species Within the Action Area

The action area functions as a migratory corridor for adult Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead, and provides migration and rearing habitat for juveniles of these species. A large proportion of all Federally listed Central Valley salmonids are expected to utilize aquatic habitat within the action area.

a. *Sacramento River Winter-run Chinook Salmon*

Sacramento River winter-run Chinook salmon currently are present only in the Sacramento River below Keswick Dam, and are composed of a single breeding population (NMFS 1997; see *III. Status of the Species and Critical Habitat*). Spawning individuals occasionally are observed in other streams such as Clear and Battle Creeks. However, water temperatures in these streams currently are not suitable throughout the spawning and incubation period. Consequently, successful juvenile production is not expected. The entire population of adults and juveniles migrate through the lower Sacramento River and must pass through the action area.

The migration timing of listed salmon and steelhead in the action area can be approximated by assessing studies that examine run timing in the Sacramento River (*e.g.*, Hallock *et al.* 1957, Van Woert 1958, Vogel and Marine 1991, Snider and Titus 2000). Adults enter San Francisco Bay from November through June (Van Woert 1958), and migrate up the Sacramento River from December through early August (Vogel and Marine 1991). Juvenile Chinook salmon emigrate through the action area from late fall to spring. Snider and Titus (2000) observed that juvenile salmon emigrate through the lower Sacramento River, at Knights Landing, in three phases. The first phase is the initiation of emigration that is strongly linked to initial Sacramento River flow increases between mid-November and early January. Approximately 78 percent of winter-run Chinook salmon emigrate during this phase. The second phase is characterized by sustained high Sacramento River flows between early January and early March, and the third phase typically occurs one week after the release of fall-run Chinook salmon from the Coleman National Fish Hatchery. The remaining proportion of juvenile winter-run Chinook salmon emigrate during these last two phases. The age structure of emigrating juveniles is dominated by young-of-the-year fry, but also may contain some yearlings.

b. *Central Valley Spring-run Chinook Salmon*

CV spring-run Chinook salmon populations currently spawn in the Sacramento River below Keswick Dam, the low-flow channel of the Feather River, and in Sacramento River tributaries including Clear, Antelope, Mill, Deer, and Butte Creeks (CDFG 1998). The entire population of migrating adults and emigrating juveniles must pass through the action area.

Adult CV spring-run Chinook salmon enter the mainstem Sacramento River in February and March, and continue to their upstream migration into June and July (CDFG 1998). In the Sacramento River, juveniles may begin migrating downstream almost immediately following emergence from the gravel with most emigration occurring from December through March (Moyle *et al.* 1989, Vogel and Marine 1991). Snider and Titus (2000) observed that up to 69 percent of CV spring-run Chinook salmon emigrate during the first migration phase between November and early January. The remainder of the CV spring-run Chinook salmon emigrate during subsequent phases that extend into early June. The age structure of emigrating juveniles is comprised of young-of-the-year and yearlings. The exact composition of the age structure is not known, although populations from Mill and Deer Creek primarily emigrate as yearlings (Colleen Harvey-Arrison, CDFG, pers. comm., 2004).

c. *Central Valley Steelhead*

CV steelhead populations currently spawn in tributaries to the Sacramento and San Joaquin Rivers. The proportion of CV steelhead in this ESU that migrate through the action area is unknown. However, because of the relatively large amount of suitable habitat in the Sacramento River relative to the San Joaquin River, it is probably high. Adult CV steelhead may be present in the action area from June through March, with the peak occurring between August and October (Bailey 1954, Hallock *et al.* 1957). Juvenile steelhead emigrate through the action area from late fall to spring. Snider and Titus (2000) observed that juvenile steelhead emigration primarily occurs between November and June. The majority of juvenile steelhead emigrate as yearlings.

2. Status of Habitat within the Action Area

The action area is within designated critical habitat for Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon and CV steelhead. Habitat requirements for these species are similar. The essential features of freshwater salmonid habitat within the action include: adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions.

Within the action area, the Sacramento River has been transformed from a meandering waterway lined with a dense riparian corridor, to a highly leveed system under varying degrees of control over riverine erosional processes and flooding. Different types of riprap comprise the majority of shoreline habitat. Much of this existing riprap is located along the lower third of the levee, near or below the water surface. Due to the sparsity of riparian vegetation, LWD recruitment is low.

Water temperatures in the action area generally are most favorable for anadromous fish during the winter and spring months and may be warmer than desired conditions from late spring through early fall. High water temperatures primarily are caused by ambient air temperatures, but also are affected by the lack of riparian shading, and by thermal inputs from agricultural outfall water.

Habitat within the action area is primarily used as juvenile rearing habitat and as a migration corridor for adults and juveniles. The condition and function of this habitat has been severely impaired through several factors discussed in the *Status of the Species and Habitat* section of this biological opinion, including agricultural water development and land use practices, predation, and habitat fragmentation. The result has been the reduction in quantity and quality of essential habitat elements that are required by juveniles to survive and grow, such as water contamination and loss of shallow-water rearing and refugia habitat. In spite of the degraded condition, the importance of the area to the species is high because it is used for extended periods of time by a large proportion of all Federally listed anadromous fish species in the Central Valley. However, due to the currently degraded condition the function of the habitat is low.

B. Factors Affecting the Species and Habitat in the Action Area

The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round. Current flood control practices require peak flood discharges to be held back and released over a period of weeks. Consequently, the river often remains too high and turbid to provide quality rearing habitat.

Levee construction and bank protection have affected salmonid habitat availability and the processes that develop and maintain preferred habitat by reducing floodplain connectivity, changing riverbank substrate size, and decreasing riparian habitat and SRA cover. Individual bank protection sites typically range from a few hundred to a few thousand linear feet in length. Such bank protection generally results in two levels of impacts to the environment: (1) site-level impacts which affect the basic physical habitat structure at individual bank protection sites; and (2) reach-level impacts which are the accumulated impacts to ecosystem functions and processes that accrue from multiple bank protection sites within a given river reach (USFWS 2000). Revetted embankments result in loss of sinuosity and braiding and reduce the amount of aquatic habitat.

The use of rock armoring limits recruitment of LWD because the relatively smooth and homogenous surface facilitates the downstream transportation on instream debris, and greatly reduces, if not eliminates, the retention of LWD once it enters the river channel. Riprapping creates a relatively clean, smooth surface which diminishes the ability of LWD to become securely snagged and anchored by sediment. LWD tends to become only temporarily snagged along riprap, and generally moves downstream with subsequent high flows. Habitat value and ecological function are thus greatly reduced, because wood needs to remain in place to generate maximum values to fish and wildlife (USFWS 2000). Recruitment of LWD is limited to any eventual, long-term tree mortality and whatever abrasion and breakage may occur during high flows (USFWS 2000). Juvenile salmonids likely are being impacted by reductions, fragmentation, and general lack of connectedness of remaining nearshore refuge areas because it reduces the amount of high value habitat available for them to rear and grow, and makes them more susceptible to predation in the open water.

High water temperatures also limit habitat availability for listed salmonids in the lower Sacramento River (Boles *et al.* 1988). High summer water temperatures in the lower Sacramento River can exceed 72 °F, and create a thermal barrier to the migration of adult and juvenile salmonids (Kjelson *et al.* 1982, Rich 1997). In addition, water diversions, for agricultural and municipal purposes have reduced river flows and increased temperatures during the critical summer months limiting the survival of juvenile salmonids (Reynolds *et al.* 1993).

Water diversions also entrain and kill juvenile and adult salmon and steelhead. Entrainment monitoring and entrainment studies have documented losses for juvenile Chinook salmon and steelhead (Hallock and Van Woert 1959, Hanson 1996, Hanson and Bemis 1997, Hanson 2001). Hallock and Van Woert (1959) used a fyke net in the Sutter Mutual Water Company's Tisdale plants Nos. 1 and 2. Nets sampled the discharge from two 48-inch diameter pumps between May 23 and September 18, 1954. Thirty seven juvenile salmon were captured in 479 hours of netting. Hanson (2001) used fishery monitoring data at the RD 108 Wilkins Slough pumping station, and at RD 1004 to establish a reasonable likelihood that listed juvenile salmonids also are taken at Sutter Mutual pump stations, directly across the Sacramento River from the action area. The Boyers Bend, Howells Landing, and Tyndall Mound diversions located in the action area were constructed in the 1950s. The pumping plants have been operated as unscreened diversions since their initial installation. Until these diversions are screened, entrainment of juveniles is expected to result in the continued injury and death of juvenile salmon and steelhead.

In 1997, RD 108 signed a letter of intent with NMFS, DFG, USFWS, and BOR, committing to work cooperatively to develop solutions to prevent the entrainment of fish at RD 108's seven pumping plants. Under the letter of intent, RD 108 constructed the Wilkins Slough Positive Barrier Fish Screen project with Federal and State funding in 2000.

C. Likelihood of species continued use of habitat within the action area

The action area is located within a reach of the Sacramento River that is utilized by nearly all listed anadromous fish populations within the Sacramento River basin. Winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead will continue to utilize the action area as a migratory corridor and for rearing. Because of the size and location of the action area, a large proportion of each ESU utilizes the action area as a migratory corridor or for rearing, making it an important node of habitat for the survival and recovery of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead.

V. EFFECTS OF THE ACTION

This section discusses the direct and indirect effects of the construction and operation of the RD 108 Combined Pumping Plant and Fish Screen project on Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead, and/or their designated critical habitat that are expected to result from the proposed action. Cumulative effects (*i.e.*, effects of future State, local, or private actions on endangered and threatened species or critical habitat) are discussed separately.

A. Approach to the Assessment

Pursuant to section 7(a)(2) of the ESA (16 U.S.C. §1536), Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The regulatory definition of adverse modification has been invalidated by the courts. Until a new definition is adopted, NMFS will evaluate destruction or adverse modification of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species. This biological opinion assesses the effects of the construction, and operations and maintenance of the RD 108 Combined Pumping Plant and Fish Screen project on endangered Sacramento River winter-run Chinook salmon, threatened CV spring-run Chinook salmon, threatened CV steelhead, and their designated critical habitat. Impacts related to replacement of nearshore aquatic habitat with the fish screen structure also will be assessed. The proposed project is likely to cause adverse short-term effects to listed species and critical habitat during construction, and provide long-term protection from entrainment. The project includes integrated design features to avoid and minimize many potential on-site impacts. The project also includes off-site conservation measures to compensate for unavoidable temporal and spatial impacts.

In the *Description of the Proposed Action* section of this biological opinion, NMFS provided an overview of the action. In the *Status of the Species* and *Environmental Baseline* sections of this biological opinion, NMFS provided an overview of the threatened and endangered species and critical habitat that are likely to be adversely affected by the activity under consultation.

Regulations that implement section 7(b)(2) of the ESA require biological opinions to evaluate the direct and indirect effects of Federal actions and actions that are interrelated with or interdependent to the Federal action to determine if it would be reasonable to expect them to appreciably reduce listed species' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (16 U.S.C. §1536; 50 CFR 402.02). Section 7 of the ESA and its implementing regulations also require biological opinions to determine if Federal actions would destroy or adversely modify the conservation value of critical habitat (16 U.S.C. §1536).

NMFS generally approaches "jeopardy" analyses in a series of steps. First, we evaluate the available evidence to identify the direct and indirect physical, chemical, and biotic effects of proposed actions on individual members of listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to something in the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering its spawning substrate, altering its ambient temperature regimes; or adding something novel to a species' environment - such as introducing exotic competitors or a sound). Once we have identified the effects of an action, we evaluate the available evidence to identify a species' probable response (including behavioral responses) to those effects to determine if those effects could reasonably be expected to reduce a species' reproduction, numbers, or distribution (for example, by changing birth, death, immigration, or emigration rates; increasing the age at which individuals reach sexual maturity; decreasing the age at which individuals stop reproducing; among others). We then use the evidence available to determine if these reductions, if there are any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

To evaluate the effects of the proposed action, NMFS examined proposed construction activities, operations and maintenance activities, habitat loss, and conservation measures, to identify likely impacts to listed anadromous salmonids within the action area based on the best available information.

The primary information used in this assessment includes fishery information previously described in the *Status of the Species* and *Environmental Baseline* sections of this biological opinion; studies and accounts of the impacts of water diversions and in-river construction activities on anadromous species; and documents prepared in support of the proposed action, including the April 2005, ASIP (BOR 2005).

The effects of RD 108's water diversions pursuant to BOR's long-term water contracts on Federally listed anadromous salmonids were previously analyzed in the OCAP BO. The OCAP BO determined that the anticipated level of take related to such water diversions is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, or CV steelhead, and is not likely to destroy or adversely modify their designated critical habitat. Therefore, water diversions that are part of standard operations will not be further assessed in the biological opinion.

B. Assessment

The assessment will consider the nature, duration, and extent of the proposed action relative to the migration timing, behavior, and habitat requirements of Federally listed anadromous fish. This assessment will consider construction impacts, operations and maintenance impacts, and impacts of habitat modification and loss associated with replacement of nearshore aquatic habitat with the fish screen structure and placement of riprap.

1. Construction Impacts

Potential construction-related impacts include exposure of juvenile and adult salmon and steelhead to noise and high sound pressure levels and increased turbidity during cofferdam installation and removal; entrainment behind the cofferdam; injury or death during fish rescue and relocation; and permanent loss of nearshore riverine habitat to the fish screen structure. Construction activities that occur behind the cofferdam are not likely to adversely affect salmon and steelhead because they will be isolated from the Sacramento River, and stabilized prior to cofferdam removal. Decommissioning activities also are not likely to adversely affect salmon and steelhead because they will occur at a time of year that avoids peak migration periods, and because existing shoreline and in-water habitat features will not be modified as a result of decommissioning actions.

a. *Cofferdam Installation and Removal*

Installation of sheet pile and beams during construction of the cofferdam will be performed using barge-mounted impact pile driver. The bottom substrate is expected to be soft based on results of core sampling at the site and similar substrate conditions encountered during installation of the cofferdam during construction of the RD 108 Wilkins Slough fish screen, which is located within a few miles of the project. Pile driving will last up to 60 days and will be on an intermittent and short duration basis (*i.e.*, hours or days). Pile driving will produce underwater sound pressure levels that may cause temporary disturbance within the Sacramento River and affect salmonid behavior and physiology through disruption of migration, feeding behavior, and potential increased exposure of juveniles to predation by forcing them from nearshore refugia.

The effect pile driving has on fish depends upon the pressure, measured in decibels (dB), of a sound or compression wave. Rassmusen (1967) found that immediate mortality of juvenile salmonids may occur at sound pressure levels exceeding 204 dB. Sustained sound pressures (four hours) in excess of 180 dB damaged the hair cells in the inner ear of cichlids (Hastings *et al.* 1996).

Feist *et al.* (1992) found that pile driving in Puget Sound created sound within the range of salmonid hearing that could be detected at least 600 meters away. Abundance of juvenile salmon near pile-driving rigs was reduced on days when the rigs were operating compared to non-operating days. McKinley and Patrick (1986) found that salmon smolts exposed to pulsed sound (similar to pile driving) demonstrated a startle or avoidance response, and Anderson (1990) observed a startle response in salmon smolts at the beginning of a pile-driving episode but found that after a few poundings of the pilings fish were no longer startled. This suggests that pile driving or associated activity (*e.g.*, human movement, work boat operation, *etc.*) can cause avoidance of habitat in the immediate vicinity of the project site, but that fish also may become acclimated to the noise. If fish move into an area of higher predator concentration (*e.g.*, deeper water), they may experience increased susceptibility to predation and decreased survival. Fish that become acclimated may be exposed to additional project-related impacts.

At the City of Sacramento Water Treatment Plant Fish Screen Project, engineering analysis anticipated that the use of a smaller pile-driving hammer that is similar in size to the largest hammer expected to be used at the proposed project, would generate sound pressure levels of 95 to 120 dB. Actual levels were not monitored. Because of the similarities in river depth, substrate sizes, and size of the pile driver at the City of Sacramento Water Treatment Plant Fish Screen Project and the proposed project, maximum sound levels also should be similar, and below the 180 dB threshold known to cause internal tissue damage to fish. However, the levels may be high enough to affect adult and juvenile salmonids by startling fish and causing avoidance of habitats within 600 meters of the noise source. This is a conservative estimate based on observations in Puget Sound and does not take into account specific on-site variables such as river flow and riverbank morphology that may reduce the actual distance.

NMFS anticipates that pile driving that occurs when listed salmonids are present will be detectable up to 600 meters from the source, and that the sounds generated will harass juvenile salmon and steelhead by causing injury from temporary disruption of normal behaviors such as feeding, sheltering, and migrating. Disruption of these behaviors also may lead to increased predation if fish become disoriented or concentrated in areas with high predator densities. These effects should be small because pile driving will occur during the day, enabling unhindered fish passage at night during peak migration times. Additionally, given the limited and intermittent use of the hammers (*i.e.*, expected to be hours or days) the magnitude of potential adverse effects is expected to be low. Cofferdam installation also will avoid high river flow conditions, when peak juvenile migration is expected. Therefore, only a small portion of the listed ESUs should be affected.

c. *Stranding and Fish Rescue*

Juvenile salmonids may be entrained and stranded within the forebay area during cofferdam construction. Cofferdam construction that occurs between September and May would correspond with the migration periods of adult and juvenile winter- and spring-run Chinook salmon, and steelhead. Adults are strong swimmers, and are likely to avoid construction-related disturbance during sheet pile driving, and avoid being entrained or stranded. Juvenile salmon and steelhead also demonstrate a startle or avoidance response to noise (Anderson 1990). However, since juveniles are weaker swimmers than adults, they may not be able to overcome ambient flow conditions and could become entrained and stranded. We anticipate that the number of juveniles entrained and stranded in cofferdams will be low because cofferdams will not be installed during high river flows that correspond with peak juvenile migration periods.

As the water level behind the cofferdam is drawn down to allow construction of the fish screen in the dry, salmon and steelhead will be rescued (*i.e.*, netted) and returned to the river according to the Fish Rescue Program prepared for the project. Only one fish rescue event is anticipated.

Although salmonids recover well from capture, handling, and short relocations, there may be incidental injury and death to individuals during the rescue. We expect that the rescue program will not capture and release every entrained juvenile. Results of a similar fish rescue operation behind the cofferdam installed during construction of the RD 108 Wilkins Slough fish screen showed that no salmonids were stranded, and fewer than 10 fish total were collected in the fish rescue. Since construction methods and schedules for the RD 108 Combined Pumping Plant and Fish Screen project are similar to past construction of the RD 108 Wilkins Slough fish screen, and a similar fish rescue protocol will be applied when the cofferdams are closed, the loss of salmonids to stranding is expected to be low.

d. *Exposure to Increased Turbidity and Contaminants*

Cofferdam installation, dredging, and site preparation will result in increased short-term, localized turbidity and suspended sediment concentrations within the Sacramento River. Exposure to increased turbidity, and suspended sediment may affect Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead through disruption of normal feeding and migration behavior, and expose juveniles to increased predation by forcing them from shallow water refugia into the open water of the river channel. The period of increased turbidity would be limited to pre-project dredging and installation of the cofferdams, which will require approximately 60 days. Increased turbidity and suspended sediments would occur intermittently during construction of the cofferdam.

Numerous studies show that suspended sediment and turbidity levels moderately elevated above natural background values can result in non-lethal detrimental effects to salmonids. Suspended sediment affects salmonids by decreasing reproductive success, reducing feeding success and growth, causing avoidance of rearing habitats, and disrupting migration cues (Bash *et al.* 2001). Sigler *et al.* (1984) in Bjornn and Reiser (1991), found that prolonged turbidity between 25 and 50 NTUs reduced growth of juvenile coho salmon and steelhead. Macdonald *et al.* (1991) found that the ability of salmon to find and capture food is impaired at turbidities from 25 to 70 NTUs. Bisson and Bilby (1982) reported that juvenile coho salmon avoid turbidities exceeding 70 NTUs. Increased sediment delivery can also fill interstitial substrate spaces and reduce cover for juvenile fish (Platts *et al.* 1979) and abundance and availability of aquatic invertebrates for food (Bjornn and Reiser 1991). We expect turbidity to affect Chinook salmon and steelhead in much the same way that it affects other salmonids, because of similar physiological and life history requirements between species.

Newcombe and Jensen (1996) believe that impacts on fish populations exposed to episodes of high suspended sediment may vary depending on the circumstance of the event. They also believe that wild fish may be less susceptible to direct and indirect effects of localized suspended sediment and turbidity increases because they are free to move elsewhere in the system and avoid sediment related effects. They emphasize that the severity of effects on salmonids depends not only on sediment concentration, but also on duration of exposure and the sensitivity of the affected life stage.

Suspended sediment from construction activities would increase turbidity at the project site and could continue downstream. Although Chinook salmon and steelhead are highly migratory and capable of moving freely throughout the action area, an increase in turbidity may injure juvenile salmonids by temporarily disrupting normal behaviors that are essential to growth and survival such as feeding, sheltering, and migrating. Injury is caused when disrupting these behaviors increases the likelihood that individual fish will face increased competition for food and space, and experience reduced growth rates or possibly weight loss. The ASIP (BOR 2005) concludes that the project has the potential to locally increase ambient sediment concentrations during low flow periods from 20 to 27 milligrams per liter (mg/l), or by about 30 to 40 percent. At the higher range of anticipated flows, sediment concentrations would increase from 100 to 107 mg/l, or approximately 7 percent. In either case, suspended sediment concentrations do not exceed the Regional Board Standard of 260 mg/l, and are well below levels measured in NTUs that cause sublethal physiological effects to salmonids. Therefore, we do not expect any injury to listed fish from temporary, localized increases in turbidity.

Project-related turbidity increases may affect the sheltering ability of some juvenile salmon and steelhead and may cause injury or death by increasing the susceptibility of some individuals to predation. The extent of these effects is expected to be small for several reasons. First, the highest turbidity levels will occur at the end of the seasonal juvenile migration period and should affect only a few individuals of each population. Second, the overall period in which turbidity increases will be short, lasting approximately 60 days. This will also limit the number of individual fish that are exposed and potentially affected. Additionally, based on observations during similar construction activities in the Sacramento River, turbidity plumes are not expected to extend across the Sacramento River, but rather the plumes are expected to extend downstream from the site along the eastern side of the channel, affecting only a portion of the fish within the action area. Turbidity plumes may be as wide as 100 feet, and extend downstream for up to 1,000 feet. Once construction stops, water quality is expected to return to background levels within hours. Adherence to erosion control measures and BMPs such as use of silt fences, straw bales and straw wattles will minimize the amount of project-related sediment and minimize the potential for post-construction turbidity changes.

As a result of the limited timing and distribution of any sediment plumes generated during construction, salmon and steelhead will have the opportunity to avoid the plume during their upstream or downstream migration. Therefore turbidity-related effects that prevent successful upstream and downstream migration are not anticipated.

Fuel spills or use of toxic compounds during project construction could release toxic contaminants into the Sacramento River and could injure or kill salmon and steelhead. NMFS expects that adherence to BMPs that dictate the use, containment, and cleanup of contaminants will minimize the risk of introducing such products to the waterway because the prevention and contingency measures will require frequent equipment checks to prevent leaks, will keep stockpiled materials away from the water, and will require that absorbent booms are kept on-site to prevent petroleum products from entering the river in the event of a spill or leak. If BMPs are successfully implemented, NMFS does not expect fuel spills or toxic compounds to cause injury or death to individual fish.

2. Operations and Maintenance Impacts

Operations and maintenance activities will be performed to divert approximately 300 cfs of Sacramento River water between April 1 and October 30 to maintain the design criteria of the RD 108 Combined Pumping Plant and Fish Screen.

The proposed fish screen project would not result in a change in the seasonal distribution of diversion operations that was previously analyzed in the OCAP BO. Although the diversion capacity of the combined pumping plant will be approximately 77 cfs less than the existing diversion capacity, BOR does not expect that overall annual water consumption will decrease because volume will be made up by periods of more continuous pumping operations. Continued operation of the pumps will remove up to 5 percent of the flow of the Sacramento River throughout each diversion season.

Operations and maintenance of the fish screen will reduce fish entrainment at the pumping facilities, but also may cause limited adverse effects to fish exposed to the structure and maintenance operations. Fish exposure to screens and associated features may affect some individuals through direct physical injury or by altering swimming behavior and causing an increased vulnerability to predation. The anticipated exposure time of 30 seconds, and the approach and sweeping velocities at the screen will prevent and minimize these effects. The fish screen also has been designed to have a smooth exterior surface and upstream and downstream transition areas that reduce or eliminate areas where juvenile salmonids are concentrated or disoriented to reduce the risk of predation, as well as to reduce or eliminate structural locations offering cover for predatory fish.

There is a potential for fish to be injured or killed along the surface of the screen if the hydraulic conditions specified in the NMFS design criteria are not met. Factors that could affect screen performance are debris and sediment accumulation at the fish screen structure. Debris and sediment accumulations could result in increased approach velocities and loss of hydraulic uniformity at the screen face. Several operations and maintenance elements have been incorporated in the facility to avoid or minimize this occurrence. The mechanical brush cleaning system will be used when the facility is operating to remove debris from the face of the fish screen. A sediment jetting system will be used to re-suspend sediment that accumulates in the fish screen forebay and operation of the pumps will remove the turbid water. Periodic dredging of the forebay will remove additional accumulations of sediment. Dredging in front of the fish screen is not expected due to the location of the site on the outside of a bend in the Sacramento River. Long-term use of the brush cleaning and sediment jetting system, along with periodic dredging in the fish screen forebay, maintenance and replacement of fish screen parts is expected to maintain the fish screen criteria for the life of the project.

Maintenance actions such as dredging and screen replacement will be infrequent and occur in the enclosed fish screen forebay, not in the Sacramento River. Maintenance actions, therefore, are not expected to result in injury or death of individuals.

3. Habitat Impacts

Construction of the fish screen will alter existing habitat conditions and result in a loss of unvegetated, riprapped habitat behind the fish screen. The area behind the fish screen will permanently exclude fish from approximately 300 feet and 0.1 acres of existing nearshore aquatic habitat along the Sacramento River levee.

Anadromous fish are present seasonally in the action area. The surrounding habitat is characterized as a narrow river channel confined by levees, stabilized with riprap, and having a relatively deep, high velocity channel with no floodplains and sparse riparian vegetation. Because of these habitat conditions, the action area does not provide favorable rearing conditions for salmon or steelhead, and primarily functions as a migration corridor. The area is not used as spawning habitat by salmonids. Because of the poor condition of excluded habitat, and projected high sweeping velocities through the action area, the impacts of habitat loss on juvenile growth should be small. The function of the action area as a migratory corridor will not be affected by the loss of habitat behind the fish screen.

The replacement of the existing 50 feet of riprap (*i.e.*, 25 feet on each side of the fish screen structure) with 2 to 4 foot-diameter rock will maintain existing predator habitat availability throughout the action area. Predation studies indicate that juvenile salmon and steelhead also may be exposed to increased susceptibility to predation by native and introduced fish species along riprapped banks (Peters *et al.* 1998, USFWS 2000). Predatory fish in the lower Sacramento River have a broad tolerance of environmental conditions and are distributed throughout the action area. Potential predator species include Sacramento pikeminnow, striped bass, largemouth bass, and smallmouth bass (*Micropterus dolomieui*). There are no available studies that quantify the predation of risk of salmon and steelhead along riprapped banks of the Sacramento River. However, studies on the Feather River (Cavallo *et al.* 2003), Sacramento River (Michny and Deibel 1986, Michny 1989) and in several other western states (Peters *et al.* 1998, Tiffan *et al.* 2002) have shown lower salmonid rearing densities and higher predator densities along armored banks. The U.S. Army Corps of Engineers (2004) also assumes that mortality is highest for juvenile fish along armored banks because they provide predator access, and lowest along natural banks with gravel and cobble sized materials because they exclude predators. Although predation is expected to increase with the additional application of riprap, the habitat modification will not be substantial, and any increase in the predation rate should be relatively small since the banks are already rocked. The application of additional rock is not expected to change the overall existing suitability of nearshore habitat for rearing and migration.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Ongoing agricultural activities likely will continue to cause entrainment into diversions, adversely affect water quality, fragment habitat availability, and thus result in cumulative effects to listed Chinook salmon and steelhead in the form of injury and death from entrainment, water contamination, and predation.

VII. INTEGRATION AND SYNTHESIS

A. Impacts of the Proposed Action on Sacramento River Winter-run Chinook Salmon, Central Valley Spring-run Chinook Salmon, and Central Valley Steelhead

NMFS finds that the proposed action will affect Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead through construction-related impacts, operations, and habitat modification and loss at the project site. Because the proposed project facilities will be constructed in a location that avoids impacts to sensitive habitats, isolated from the Sacramento river behind a cofferdam, and because the project incorporates a suite of impact avoidance and minimization measures, the potential adverse effects of the proposed project are small, limited, or short-term in nature.

Construction-related impacts are limited to cofferdam installation, cofferdam dewatering, and implementation of the fish rescue. Cofferdam installation will cause temporary increases in underwater sound pressure and turbidity levels, and may injure or kill juveniles by causing physical trauma or causing increased susceptibility to predation. Cofferdam installation will occur between April 1 and November 1, and will take approximately 60 days to complete. The cofferdam dewatering may isolate and strand juvenile and adult Chinook salmon and steelhead. Individuals may be entrained into pumps and killed as water is drawn down prior to the fish rescue. The fish rescue may injure or kill fish during capture, transport, and relocation to the Sacramento River. The dewatering and fish rescue are expected to be a one-time occurrence, lasting only one to two days.

Juveniles are more likely to be affected by the construction activities because of their small size, reliance on nearshore aquatic habitat, and vulnerability to factors that affect their growth and distribution. Adults should not be injured because their size, preference for deep water, and crepuscular migratory behavior should enable them to avoid construction-related impacts. Although juveniles exhibit crepuscular behavior, because of their use of near-shore aquatic habitats, they are susceptible to impacts from daytime construction activities. Construction impacts following the 60-day cofferdam installation period should be small to negligible because most work will be performed behind cofferdams, and other in-channel work will avoid peak juvenile outmigration and adult upstream migration periods.

Turbidity-related injury and predation will be minimized by implementing the proposed conservation measures such as implementation of BMPs, and adherence to Regional Board water quality standards. Adherence to BMPs is expected to prevent fuel spills and the release of other toxic compounds from causing injury or death to individuals. The fish rescue will minimize the mortality of fish that are entrained or stranded within cofferdams.

Operations and maintenance actions will occur annually for the lifespan of the project. Conservation measures and integrated design features are expected to minimize or avoid adverse operations and maintenance effects by maintaining the fish screen to NMFS criteria, repairing or replacing damaged parts, and avoiding peak migration periods during maintenance activities. Near-screen conditions are expected to be favorable for survival and because NMFS and CDFG fish screen criteria will be met under a large range of river flow and pumping conditions. Injury and death rates for operations and maintenance activities should be low.

Maintenance actions such as dredging and screen replacement will be infrequent and occur in the enclosed fish screen forebay, not in the Sacramento River. Maintenance actions, therefore, are not expected to result in injury or death of individuals.

Overall, NMFS expects that the construction and operation of the RD 108 fish screen, and the concurrent decommissioning and removal of three unscreened diversion facilities with a combined pumping capacity of 377 cfs, will significantly reduce juvenile Chinook salmon and steelhead entrainment, injury, and mortality from current baseline conditions.

B. Impacts of the Proposed Action on ESU Survival and Recovery

The adverse effects to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead within the action area are not expected to affect the overall survival and recovery of the ESUs. This is largely due to the fact that construction impacts will be temporary, and will be minimized through the implementation of the proposed conservation measures. Construction-related impacts will not impede adult fish from reaching upstream spawning and holding habitat, or juvenile fish from migrating to downstream rearing areas. The number of juveniles actually injured or killed is expected to be small compared to the sizes of the respective juvenile salmonid populations and is not likely to result in reduced adult returns; therefore, adverse population-level impacts are not anticipated.

The long-term operation of the fish screen will substantially reduce entrainment and related mortality of juvenile Chinook salmon and steelhead. Because construction impacts are expected to be temporary and avoid peak migration periods, and because the consolidated pumping and fish screen facility will reduce entrainment and increase juvenile survival in the Sacramento River, the proposed action is not expected to reduce the likelihood of survival and recovery of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead within the action area.

C. Impacts of the Proposed Action on Critical Habitat

Impacts to the designated critical habitat of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon and CV steelhead include the permanent loss of approximately 300 linear feet, and 0.1 acre of existing nearshore aquatic habitat along the Sacramento River levee. Habitat elements within the action area, such as LWD, SRA cover, shoreline habitat complexity, and refugia, currently are degraded, fragmented and do not contribute beneficially to the conservation value of critical habitat. The proposed habitat modifications and loss are relatively small and similar to existing site conditions, and the action area is expected to function primarily as a migration corridor for listed salmonids. Therefore, we do not expect project-related impacts to result in a reduction to the conservation value of critical habitat.

VIII. CONCLUSION

After reviewing the best available scientific and commercial information, the current status of CV spring-run Chinook salmon, CV steelhead, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the RD 108 Combined Pumping Plant and Fish Screen project, as proposed, is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, or CV steelhead, and is not likely to destroy or adversely modify the conservation value of their designated critical habitat.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS as an act which kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by BOR so that they become binding conditions of any grant or permit, as appropriate, for the exemption in section 7(o)(2) to apply. BOR has a continuing duty to regulate the activity covered by this incidental take statement. If BOR: (1) fails to assume and implement the terms and conditions, or (2) fails to require the contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, BOR must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

A. Amount or Extent of Take

NMFS anticipates incidental take of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead, through construction-related impacts, operations and maintenance impacts, and habitat modification and loss at the project site. Specifically, NMFS anticipates that juvenile listed salmonids may be killed, injured, or harassed during construction and operations and maintenance activities. NMFS does not anticipate take of adults.

NMFS cannot, using the best available information, quantify the anticipated incidental take of individual Sacramento River winter Chinook salmon, CV spring-run Chinook salmon, and CV steelhead because of the variability and uncertainty associated with the population size of each species, annual variations in the timing of migration, and uncertainties regarding individual habitat use of the project area. However, it is possible to describe the conditions that will lead to the take.

Accordingly, NMFS is quantifying take of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead incidental take in terms associated with the extent and duration of construction activities, operations and maintenance activities, and as the extent of habitat loss or modification. Although the exact percentage of each ESU that will be affected cannot be determined, because of the small size of the project and the brief exposure time that fish will face, a small, and unknown percentage of each population will be harmed, injured, or killed.

It is anticipated that construction-related take will be in the form of harm, harassment, or death from physical injury or predation related to increased underwater sound pressure levels and turbidity, entrainment within the cofferdam, stranding, and physical injury or death from cofferdam installation, dewatering, and fish rescue efforts. Construction-related take is expected to last for 60 days until the cofferdam is installed and dewatered. Operations-related take in the form of injury and death are anticipated from physical injury of individuals that contact the screen face, and continued exposure to project features such as riprap that contributes to predation of juveniles. The following level of incidental take from project activities is anticipated:

1. All rearing or migrating juvenile winter- and spring-run Chinook salmon and steelhead injured or killed from pile driving between April 1 and November 1 of the first construction year to construct the cofferdam. Take in the form of injury and death from pile driving is not expected to occur for more than a total of 60 days and extend more than 600 meters from the sound source. Underwater sound levels are not expected to exceed 180 dB anywhere within a 600 meter radius of the sound source.

2. Take in the form of injury and death from predation is expected from turbidity levels within the Regional Board standards listed in the *Description of the Proposed Action* section, within a 60 day time period between April 1 and November 1 of the first construction year, extending downstream for up to 600 meters.

3. Take in the form of capture, injury and death is expected from the fish rescue that will occur within enclosed cofferdams between April 1 and November 1 of the first construction year. Death from fish rescue efforts is not expected to exceed 2 percent of fish captured.

4. All rearing or migrating juvenile winter- and spring-run Chinook salmon and steelhead injured or killed from pumping plant and fish screen operations. Operations-related take is expected in the form of injury and death of juveniles from exposure to the fish screen and associated in-river project features resulting from a diversion of up to 300 cfs of water from the Sacramento River.

Anticipated incidental take may be exceeded if project activities exceed the criteria described above, or if the project is not implemented as described in the ASIP for the RD 108 Combined Fish Pumping Plant and Fish Screen project (BOR 2005).

B. Effect of the Take

NMFS has determined that the above level of take is not likely to jeopardize Sacramento River winter-run Chinook salmon, CV steelhead, or CV spring-run Chinook salmon. The effect of this action will consist of fish behavior modification, loss of habitat value, and potential death or injury of juvenile Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, or CV steelhead.

C. Reasonable and Prudent Measures

NMFS has determined that the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the incidental take of listed anadromous salmonids.

1. Measures shall be taken to minimize injury and mortality from project construction, operations, and maintenance.

2. Measures shall be taken to maintain, monitor, and adaptively manage all conservation measures throughout the life of the project to ensure their effectiveness.

3. Measures shall be taken to minimize the effect of habitat modifications at the project site.

D. Terms and Conditions

1. Measures shall be taken to minimize injury and mortality from project construction, operations, and maintenance.

a. BOR shall require RD 108 and its contractors to use low-flow pumps with screened intakes during cofferdam dewatering activities.

2. Measures shall be taken to maintain, monitor, and adaptively manage all project elements and conservation measures throughout the life of the project to ensure their effectiveness.

   a. BOR shall require RD 108 to provide a project summary and compliance report to NMFS within 60 days of completion of the proposed action, and once per year at the end of the irrigation season. The 60-day report shall describe construction dates, implementation of project conservation measures, compliance monitoring and compliance with the terms and conditions of this biological opinion; observed or other known effects on the Sacramento River winter-run Chinook salmon, if any; and any occurrences of incidental take of the Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead. The annual report shall summarize operation and maintenance actions taken to ensure compliance with NMFS fish screen criteria. The purpose of these reports is to validate that factors contributing to incidental take are within ranges that are consistent with the amount and extent of take are analyzed.

   b. BOR shall provide a detailed operations and maintenance plan within one year of completion of the proposed action.

   c. BOR shall notify NMFS upon initiation of in-water construction and implementation of the Fish Rescue Program.

3. Measures shall be taken to minimize the effect of habitat modifications at the project site.

   a. BOR shall require RD 108 to use the smallest size of rock riprap as practicable to maintain bank stability and fish screen performance, while minimizing habitat modifications that will increase predator habitat.

   b. BOR shall require RD 108 to replace riparian vegetation that is lost or damaged to construction at a three to one ratio, calculated on an acreage basis. Replacement vegetation shall consist of native plant species appropriate for the area.

Reports and notifications required by these terms and conditions shall be submitted to:

Supervisor
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento California 95814-4706
FAX: (916) 930-3629
Phone: (916) 930-3600

X. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. These conservation recommendations include discretionary measures that BOR can implement to avoid or minimize adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. NMFS provides the following conservation recommendations that would avoid or reduce adverse impacts to listed salmonids:

1. Measures should be taken to evaluate and minimize injury and mortality at other diversion points along the Sacramento River that are owned and operated by RD 108.

2. RD 108 should monitor entrainment at the State Ranch Bend and Portuguese Bend Pumping Plants, and coordinate with the Anadromous Fish Screen Program to prioritize the screening of these facilities.

3. BOR should encourage bank protection efforts using biotechnical approaches, which may then preclude the need for rock fill and/or rock riprap to achieve engineering goals.

4. BOR should implement biotechnical measures in place of traditional revetment techniques should any of the riprap begin to cause scour and require additional bank stabilization.

5. BOR should conduct or fund studies to help quantify fish losses at water diversions, and prioritize fish screen projects for future funding.

6. BOR should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects within the lower Sacramento River.

To be kept informed of actions minimizing or avoiding adverse effects, or benefiting listed and proposed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

XI. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed RD 108 Combined Pumping Plant and Fish Screen project. Reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in any incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the action, including the avoidance, minimization, and compensation measures listed in the *Description of the Proposed Action* section is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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Enclosure 2

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

Agency:	U.S. Bureau of Reclamation' Mid-Pacific Region
Activity:	Reclamation District 108 Combined Pumping Plant and Fish Screen project
Consultation Conducted By:	NOAA's National Marine Fisheries Service

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

This document represents NOAA's National Marine Fisheries Service's (NMFS) Essential Fish Habitat (EFH) consultation based on our review of information provided by the U.S. Bureau of Reclamation (BOR) on the Reclamation District 108 (RD 108) Combined Pumping Station and Fish Screen project in Yolo County and Sutter County, California. The Magnuson-Stevens Fishery Conservation Act (MSA) as amended (U.S.C 180 et seq.) requires that EFH be identified and described in Federal fishery management plans. Federal action agencies must consult with NMFS on activities which they fund, permit, or carry out that may adversely affect EFH. NMFS is required to provide EFH conservation and enhancement recommendations to the Federal action agencies. The geographic extent of freshwater EFH for Pacific salmon in the Sacramento River includes waters currently or historically accessible to salmon within hydrologic units 18020109 (lower Sacramento River) and 18020112 (upper Sacramento River to Clear Creek).

EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat, "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers all habitat types used by a species throughout its life cycle.

The biological opinion for the RD 108 Combined Pumping Plant and Fish Screen project addresses Chinook salmon listed under the both the Endangered Species Act (ESA) and the MSA that potentially will be affected by the proposed action. These salmon include Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), and Central Valley spring-run Chinook salmon (*O. tshawytscha).* This EFH consultation will concentrate on Central Valley fall-/late fall-run Chinook salmon (*O. tshawytscha*) because they are covered under the MSA but not listed under the ESA.

Historically, Central Valley fall-run Chinook salmon generally spawned in the Central Valley and lower-foothill reaches up to an elevation of approximately 1,000 feet. Much of the historical fall-run spawning habitat was located below existing dam sites and the run therefore was not as severely affected by water projects as other runs in the Central Valley.

Although fall-run Chinook salmon abundance is relatively high, several factors continue to affect habitat conditions in the Sacramento River, including loss of fish to unscreened agricultural diversions, predation by warm-water fish species, lack of rearing habitat, regulated river flows, high water temperatures, and reversed flows in the Sacramento-San Joaquin Delta (Delta) that draw juveniles into State and Federal water project pumps.

A. Life History and Habitat Requirements

Central Valley fall-run Chinook salmon enter the Sacramento River from July through December, and late fall-run enter between October and March. Fall-run Chinook salmon generally spawn from October through December, and late fall-run fish spawn from January to April. The physical characteristics of Chinook salmon spawning beds vary considerably. Chinook salmon will spawn in water that ranges from a few centimeters to several meters deep provided that the there is suitable sub-gravel flow (Healey 1991). Spawning typically occurs in gravel beds that are located in marginally swift riffles, runs and pool tails with water depths exceeding one foot and velocities ranging from one to 3.5 feet per second. Preferred spawning substrate is clean loose gravel ranging from one to four inches in diameter with less that five percent fines (Reiser and Bjornn 1979).

Fall-run Chinook salmon eggs incubate between October and March, and juvenile rearing and smolt emigration occur from January through June (Reynolds *et al.* 1993). Shortly after emergence, most fry disperse downstream towards the Delta while finding refuge in shallow waters with bank cover formed by tree roots, logs, and submerged or overhead vegetation (Kjelson *et al.* 1982). These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Smolts generally spend a very short time in the Delta and estuary before entry into the ocean.

II. PROPOSED ACTION

BOR, along with RD 108 propose to construct and operate a new pumping plant and fish screen, along the west bank of the Sacramento River, near river mile (RM) 110.3, and decommission and remove three existing unscreened pumping facilities at Boyers Bend (RM 111), Howells Landing (RM 109), and Tyndall Mound (RM 105.7). The proposed fish screen project is identified in the California Bay-Delta Authority (CALFED) Ecosystem Restoration Program's Draft Stage 1 Implementation Plan as a project that will result in progress towards meeting CALFED goals for at-risk salmonids. The new pumping plant and fish screen will have a diversion rate of 300 cubic feet per second (cfs), and will be constructed to meet all California Department of Fish and

Game and NMFS fish screen criteria. The combined pumping rate of the three pumping plants to be removed is approximately 377 cfs. The proposed action includes construction of new facilities, decommissioning of existing facilities, operations and maintenance, conservation measures, and monitoring.

In addition to the fish screen and pumping facilities, the consolidation of three diversion points will require changes to the canal and irrigation network. These project elements are on the inland side of the Sacramento River levee and will have no effect on Federally listed salmonids and their designated critical habitat and will not be considered further in this assessment.

The proposed action is described in the *Description of the Proposed Action* section of the preceding biological opinion (Enclosure 1).

III. EFFECTS OF THE PROJECT ACTION

The effects of the proposed action on Pacific Coast salmon EFH would be similar to those discussed in the *Effects of the Proposed Action* section of the preceding biological opinion (Enclosure 1) for endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead. A summary of the effects of the proposed action on Central Valley fall-/late fall-run Chinook salmon are discussed below.

Adverse effects to Chinook salmon habitat will result from construction-related impacts, operations and maintenance impacts, and long-term impacts related to the extensive modification and loss of aquatic and riparian habitat at the project site. Primary construction-related impacts include turbidity and suspended sediment created during cofferdam installation and dredging. Habitat impacts include the permanent loss of approximately 300 linear feet, and 0.1 acres of existing nearshore aquatic habitat along the Sacramento River levee. The placement of additional riprap along the base of the screen and upstream and downstream from the screen would impact the shoreline of the Sacramento River for a distance of approximately 50 feet. These actions will cause an immediate reduction in habitat availability, and nearshore habitat complexity and suitability.

In-channel construction activities such as dredging and cofferdam installation will cause temporary increases in suspended sediment and turbidity. Turbidity will be minimized by implementing the proposed conservation measures such as implementation of best management practices (BMPs) and adherence to Central Valley Regional Water Quality Control Board water quality standards. Fuel spills or use of toxic compounds during project construction could release toxic contaminants into the Sacramento River and could injure or kill salmon and steelhead. Adherence to BMPs that dictate the use, containment, and cleanup of contaminants will minimize the risk of introducing such products to the waterway because the prevention and contingency measures will require frequent equipment checks to prevent leaks, will keep stockpiled materials away from the water, and will require that absorbent booms are kept on-site to prevent petroleum products from entering the river in the event of a spill or leak.

Operations and maintenance actions will be conducted annually to ensure the performance of the fish screen. Most actions are expected to occur during the summer when anadromous fish are not expected to be present, or behind the fish screen structure, where impacts will not extend into areas of occupied fish habitat.

Overall, NMFS expects that the loss and modification of nearshore aquatic habitat in the action area may adversely affect the EFH of Chinook salmon through the reduction of habitat complexity necessary for growth, refugia, and survival. However, it is expected that adverse effects will be small, and reduced over time with the successful implementation of the project's conservation measures.

IV. CONCLUSION

Upon review of the effects of RD 108 Combined Pumping Plant and Fish Screen project, NMFS believes that the project will result in adverse effects to the EFH of Pacific salmon protected under the MSA.

V. EFH CONSERVATION RECOMMENDATIONS

Considering that the habitat requirements of fall-run within the action area are similar to the Federally listed species addressed in the preceding biological opinion (Enclosure 1), NMFS recommends that Terms and Conditions 2a, 2b, 2c, 3a, and 3b, as well as all the conservation recommendations in the preceding biological opinion prepared for the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead ESUs, be adopted as EFH conservation recommendations.

Section 305(b)4(B) of the MSA requires BOR to provide NMFS with a detailed written response within 30 days, and 10 days in advance of any action, to the EFH conservation recommendations, including a description of measures adopted by BOR for avoiding, minimizing, or mitigating the impact of the project on EFH (50 CFR 600.920[j]). In the case of a response that is inconsistent with our recommendations, BOR must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

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